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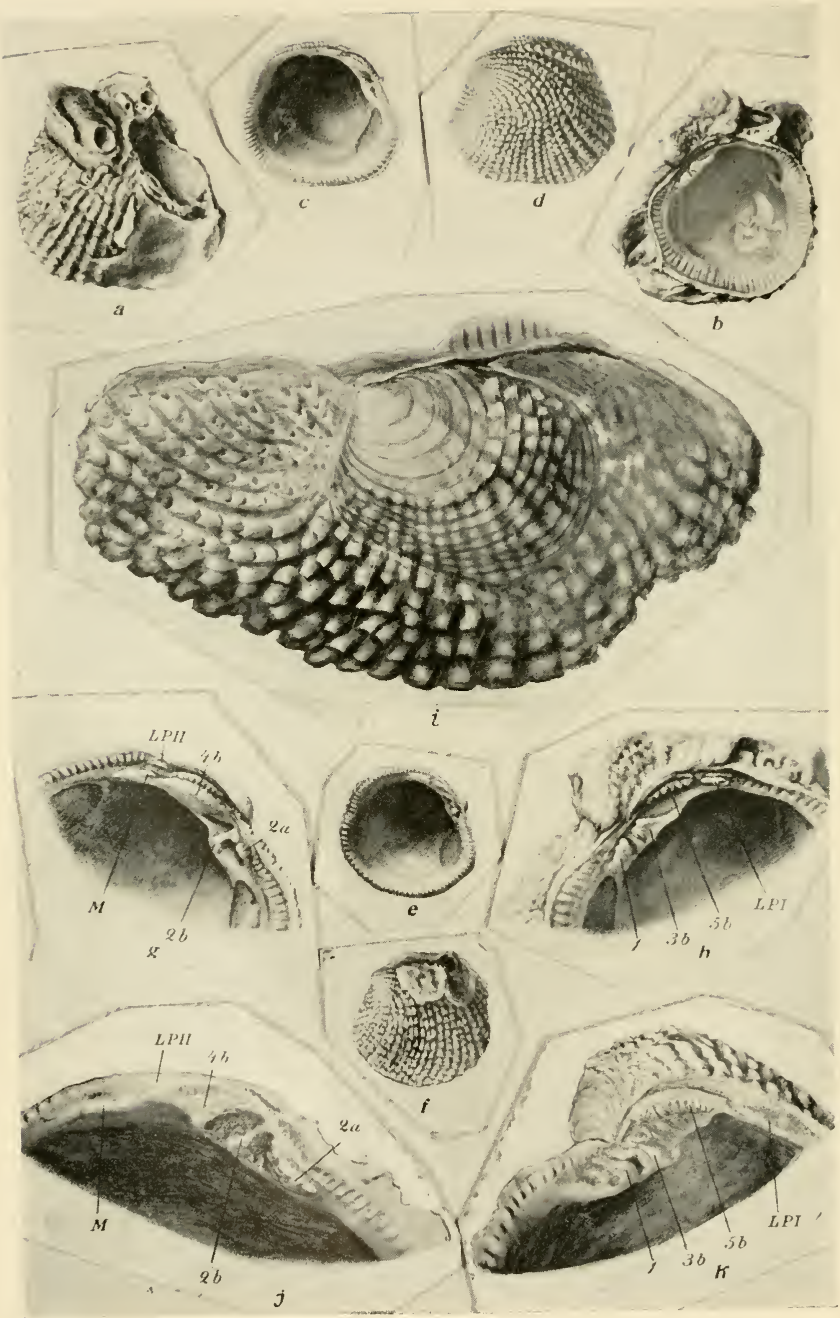

Odhner: On *Pseudochama*.
(Explanation on opposite page.)

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SOME NOTES ON PSEUDOCHAMA

By N. H. ODHNER

Stockholm

In 1919 I published an investigation on recent species and genera of the Lamellibranchiate family Chamidae of which I had in 1917 established the genus *Pseudochama*[1] for forms fixed by means of the right valve in contrast to *Chama*, or those fixed by their left valve. These two different genera proved to be distinct also in their shell (as well as soft) morphology, inasmuch as the juvenile stage still persists with the different characters preserved in the umbones of the adult shell. I held in 1919 the genus *Echinochama* Fischer 1887 as well motived on account of its characteristic sculpture; else it shares the principal features of *Pseudochama*, above all the umbonal juvenile shell, which is quite different in *Chama* both in sculpture and dentition in small free stages. It was stated, besides, that a small recent form of *Pseudochama*, *P. pusilla* n.sp., offered hinge characters primitive with regard to all other *Pseudochama*

[1] Type by subsequent designation *Chama cristella* Lamarck 1819 (cf. Gardner 1926; Nicol 1952a,b).

EXPLANATION OF FIGURES, PLATE I.

FIG. *a–i*, *Pseudochama* (*Eopseuma*) *pusilla* Odhner 1919; right valve of one specimen, exterior (*a*), interior (*b*), × 3.5; left valve of the same specimen, interior (*c*), exterior (*d*), × 3.5; a second specimen, left valve, interior (*e*), exterior (*f*), × 3.5; *g* hinge of left valve, × 7.5; *h*, hinge of right valve, × 7.5; *i* left valve with nepionic shell, × 20. From Odhner 1919.—*j*, *k*, *Pseudochama draconis* Dall 1903, hinge of left valve (*j*), hinge of right valve (*k*), × 6, D. Berg phot—*1*, *2a*, *2b* etc. cardinal teeth (Bernard's designations); LI, LII lateral teeth; *M*. marginal teeth.

(incl. *Echinochama*), a fact which caused me to establish for that new species a distinct subgenus *Eopseuma.*

Dr. D. Nicol of the U. S. National Museum has recently (1952 and 1953) in some interesting and critical papers corroborated my conclusions from 1919 and pointed out that the genus *Echinochama* is to be derived from the earlier existing *P. draconis* Dall 1903, a species that I had in 1919 already referred, from the original description by Dall, to *Pseudochama.* Nicol now (1952) states, on material studied by him, that *P. draconis* may be in reality the probable ancestor of the genus *Echinochama.*

This statement induced me to a supposition that *P. draconis* would perhaps also prove to belong in the subgenus *Eopseuma* and to be closely related to the recent *P. pusilla.* My request for material of *P. draconis* for examination was most kindly answered by Dr. Nicol, who sent, together with his publications on Chamidae, some valves of that species against other material for exchange. Unfortunately, however, there is insufficient material in the Swedish Riksmuseum for exchanging cotypes of *P. pusilla* in return.

A comparison with the valves of the latter species in Riksmuseum (from Macassar Strait) and the received *P. draconis* at once proved a close agreement in the hinge characteristics. I give here two figures (*j* and *k*) showing the tooth elements of *P. draconis* for comparison with those of *P. pusilla* reproduced from my work of 1919 with a common designation of the particulars. A still persisting bipartition of the right cardinal teeth (1 + 3b) is clearly seen, and this character is stated by me in 1919 (p. 75) as the chief significance of *Eopseuma* in contradistinction to *Echinochama* and other *Pseudochama* species; in *Echinochama* a separation of these teeth is scarcely visible and, besides, the shell has become almost equivalve, which seems to be a secondarily acquisition (Odhner 1919, p. 93; Nicol 1952c, p. 804). In the second place the sculpture of the nepionic shell should be decisive according to my table of classification (1919, p. 75).

If now the dentition of *P.* (*E.*) *pusilla* is compared with that of *P. draconis,* reproduced in figs. *j. k.,* we find a great similarity inasmuch as both parts of the right cardinal (1 + 3b) are still

distinct and well separated by a transverse deep furrow, and also other elements of the hinge of *P. pusilla* can be recognized (cf. figs. *g, h*). But they are more differentiated and altered by additional details than in *P. pusilla,* thus already on the way towards an *Echinochama* stage, where the original elements are difficult to discern.

It is true, as mentioned, that some agreement of the dentition exists between *P. draconis* and *pusilla,* but with regard to the nepionic shell structure, a still stronger resemblance is extant between *P. draconis* and *Echinochama,* as Nicol has already remarked. This similarity quite justifies Nicol's opinion that *P. draconis* "is the probable ancestor of *Echinochama*" (Nicol 1952c, p. 815). In *P. draconis* the nepionic shell is strikingly larger than in *P. pusilla* and sharper marked off in its sculpture from the remaining shell surface. It measures 1.5 mm in length and resembles that of *Echinochama arcinella* figured by me (1919, pl. 1, fig. 5), but the latter or properly nealogic one is still larger (l. about 2.4 mm, Odhner, l.c., p. 75, 93) and furnished with 6–7 concentric lamellae (Odhner, l.c., pl. 1, figs. 5, 6; p. 93), whereas in *P. draconis* there are only 5–6. This difference implies a specific distinction which may certainly be apt for separating other different species of *Pseudochama* too (cf. figures in Odhner 1919, pl. 1; p. 93).

In *P. pusilla,* on the contrary (cf. fig. *i* = pl. 2, fig. 21 of Odhner 1919), the nepionic shell is "rounded square with a few distant concentric threads and traces of some radiating posterior riblets" (l.c., p. 24). The length of the nepionic shell proves to be 1.2 mm, the number of concentric threads is 5–6 on half the valve and as many on its posterior half, where the raised lamellae (or threads) are broken into radiating rows of scales. The latter feature is a peculiarity distinguishing *P. pusilla* from both *P. draconis* and *Echinochama.* It also unequivocally shows that *P. pusilla* is essentially distinct from *P. draconis,* which, as mentioned, has only concentric sculpture and lacks every trace of radial sculpture in its nepionic shell, which besides, is more sharply limited off from the disk of the valve than in *P. pusilla.*

These comparisons in sculpture and dentition give the impression that there is less agreement in the former and more in

the latter respect, and that the agreement in the dentition may imply common stages of the development passed by both sections (*Pseudochama* and *Echinochama*), whereas the shell sculpture is a quality more independently acquired. The increasing size and lamellae of the nepionic shell, if *Eopseuma* and *Echinochama* are compared, also give support to the supposition expressed by me in 1919 (p. 92): "This nepionic stage interjacent between the prodissoconch and the permanent stage, is to be considered as a juvenile specialization or a caenogenetical larval stage, which has arisen through a development produced somewhat beyond the direct line of evolution."

When describing *P. pusilla* in 1919 from the Macassar Strait, I supposed that a second find of this species had been made by the Siboga Expedition and was represented in a small shell from its St. 79[a] and figured by Pelseneer (1911 on pl. XXI, fig. 7). This specimen seems namely to have been fixed by its right valve and to be as large as *P. pusilla* and sexually mature. In order to subject this specimen to a direct examination, I asked to borrow it from Holland, and Mrs. W. S. S. van der Feen most obligingly sent it. The specimen has a complete left valve 7.5 mm in length, and a right one, defective but evidently the moiety. Their colour is a vivid rose, deeper in the interior, paler at the margins, and both colour and sculpture completely agree with those of the typical specimens, just as do also the teeth of the left valve. Without this direct comparison, the identity could probably not have been ascertained,[2] because the Siboga specimen has its left valve umbo covered with a colony of the rosy *Polytrema miniaceum* (Pallas), a Foraminifer, which entirely hides the nepionic shell. In the right valve, the upper portion with the hinge is broken off together with the substratum of the mussel. Thus it has now been stated that this species occurs also on the Siboga Station mentioned (the Borneo Bank), not far from the type locality, or exactly 2°38′.5S, 117° 46′ E, 54 m, coral-sand.

Pseudochama draconis has a peculiar shell sculpture consisting of dense knots all over the valves but rising, towards the margins, to waved lamellae. Some variation seems to exist; the

[2] Prashad (1932, p. 298) reported this specimen from St. 79a among "young shells apparently belonging to several species of the genus *Chama*."

figure 3, pl. 119, in Nicol 1952*c*, shows a more separate arrangement and pustulate shape of the knobs, whereas in fig. 5 in the same plate they appear more in series and of a half open tubular shape, similar to those of *P. pusilla.* It may be supposed that this agreement implies a development from scales like those of *Eopseuma* and that this mode of progression, thus, is also the case with the sculpture of *Echinochama.*

In the genus *Chama* there are also differences in the sculpture of the nepionic shell, but the latter is less distinctly marked off from the valve than in *Pseudochama;* its sculpture passes, as in *Eopseuma,* more continuously into that of the valve disc. This difference is the more striking if we compare some of the fossil forms, e.g. *Chama lamellosa* Lamarck or *Ch. papyracea* Deshayes, both from the Eocene in France, with recent species (e.g. *Ch. gryphoides*). In *Ch. lamellosa* the nepionic shell grows to about 0.6 mm until it forms its first concentric lamella, and all the sequent lamellae pass gradually into the spinose undulating marginal ones. In recent species (*Ch. gryphoides* e.g.) the nepionic shell of 0.4 mm 1. is microscopically striated radially before the concentric and scaly sculpture of the adult shell begins. It seems possible to base a classification also of the species of the genus *Chama* on the different shape of the embryonic shell stages, but presently this possibility can only be remarked as a problem for future research.

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THE IDENTITY AND VALIDITY OF HYRIDELLA AUSTRALIS (LAMARCK) 1819

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Lamarck (1819) described two species of freshwater mussels, *Unio australis* and *Unio depressa*, from Australia. The descriptions were brief, without figures, and the only locality given was New Holland. *Unio depressa* was figured by Delessert (1841) and there is no doubt as to its identity, although the species was known for many years as *Unio paramattensis* Lea (1862) which is an absolute synonym of *Unio depressa* Lamarck. It is a species widely distributed along the east coast of Australia, and occurring in streams near Sydney, New South Wales, where specimens could have been collected at the time Lamarck described the species.

Unio australis was figured by Hanley (1843) but the figure was very small and of little use in identification, and Lamarck's description was repeated with it. Philippi (1847) also figured and described this species, giving the dimensions of his specimen and a full description. Possibly both these authors had studied Lamarck's types, but despite Philippi's account, its identity remained uncertain. No further attempt has been made since that time to determine this species exactly by examination of Lamarck's types as far as I know.

The freshwater mussels of Australia were reviewed by Iredale (1934; 1943) who divided them into four subfamilies, of which two included most of the Australian species. These are the subfamilies Velesunioninae and Propehyridellinae. The validity and systematic position of these subfamilies need not be considered here, but the two groups serve to differentiate the

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Australian mussels on several characters. The Velesunioninae all lack beak sculpture, and the subfamily includes the genus *Velesunio* Iredale which possesses simple lamellar cardinal teeth. The Propehyridellinae includes several genera in which the beaks are sculptured with radial ridges, and the genus *Propehyridella* Cotton and Gabriel possesses relatively complex, grooved, erect cardinal teeth.

Simpson (1900) determined a species of *Velesunio* as *Unio australis* Lamarck, and since that time the name has been applied more or less indiscriminately to species of this genus: see Simpson (1914), Haas (1924), Cotton and Gabriel (1932), for example. At no time after Simpson's account, till 1934, was the name *Unio australis* associated with a member of the Propehyridellinae.

Iredale (1934) noted the difficulties of accurately determining this species, and logically assumed that it was likely to be a species occurring near Sydney with *Unio depressa* Lamarck. A species of *Velesunio* does occur there, but it is not found in association with *depressa.* Two species of Propehyridellinae do occur in association with *depressa* however, *Propehyridella nepeanensis* (Conrad), a long-standing species, and another species which had not previously been recognised as distinct from *nepeanensis* and had not been described under any other name. This species resembled Philippi's figure, and Iredale selected it as probably being *australis.* Iredale named several subspecies of this form, including *australis drapeta* from Northern New South Wales and South Queensland. At first he placed this species in a new genus *Hyridunio,* in the subfamily Velesunioninae, but later (1943) transferred *Hyridunio* to the Propehyridellinae, as specimens with uncorroded beaks showed the characteristic beak sculpture.

During the course of research on the Australian freshwater mussels it became necessary to determine this species definitely, and M. Andre Franc, Curator of Mollusks, Museum National d'Histoire Naturelle, Paris, kindly supplied photographs of Lamarck's two specimens, with detailed descriptions. This information indicated that the types of *Unio australis* were identical with the species known for many years as *Unio nepeanensis* Conrad (1850), the type species of *Propehyridella,*

mentioned above as also occurring with *Unio depressa* Lamarck. M. Franc has compared two specimens of *nepeanensis* with Lamarck's types and finds that they are the same species. He wrote as follows: "The two smaller valves are absolutely comparable to Lamarck's larger specimen. . . . But there are less differences between your two smaller valves and Lamarck's larger two, than between the two specimens of Lamarck. . . . I think that one could affirm the identity of the two forms; it is in any case, what I would do if I had to decide this question." This difference in Lamarck's specimens might indicate that two species are represented in the type lot, but the photographs reveal only the normal differences between young and adult specimens of *nepeanensis.* The only measurement given by Lamarck was the length of the larger specimen, so that this should be considered the lectotype and is here selected as such. Thus *Unio nepeanensis* Conrad 1850 must be placed in the synonymy of *Unio australis* Lamarck 1819. The species selected by Iredale must therefore take the next available name, and becomes *Hyridunio drapeta* Iredale 1934.

The correct allocation of this specific name would be no great problem in nomenclature if it were not for the fact that the three specific names, *australis* Lamarck, *nepeanensis* Conrad, and *"australis" drapeta* Iredale, have all been designated as the type species of different genera.

Swainson (1840) named *Unio australis* Lamarck as type species of his genus *Hyridella.* For many years the name has been listed as *Hyridella australis* (Lamarck). Cotton and Gabriel (1932) still confusing *australis* with a species of *Velesunio,* named *Unio nepeanensis* Conrad as type species of their genus *Propehyridella.* Iredale (1934) pointed out that Swainson's description of the generic characters of *Hyridella* based on his "*Unio australis* Lamarck" could not apply to any Australian species, and it seemed likely that Swainson had misidentified his type species. Iredale did not attempt to determine which species Swainson really had, but proceeded to reject *Hyridella* for any Australian group. The validity of this procedure will be discussed below. Meanwhile, for the species he thought to be *australis,* Iredale gave the new generic name *Hyridunio,* and in case he later proved to be mistaken in his

determination of *australis,* he designated the subspecies *drapeta* Iredale as the type species of *Hyridunio,* in order that the latter name would be associated with the species "drapeta" and not simply with the name *australis.*

Before discussing further the validity of the names involved in this problem, some comments on the genera and species themselves are necessary. There remain only two species involved, *Unio australis* Lamarck (= *Unio nepeanensis* Conrad) and *Hyridunio drapeta* Iredale, both valid specific names and distinct species. Three generic names are involved, *Propehyridella* and *Hyridella,* each with *Unio australis* Lamarck, or a synonym as the designated type species, and *Hyridunio* with *drapeta* Iredale as type species. I consider that there are no valid grounds for maintaining the generic distinction between these two species, so that *Hyridunio* Iredale must be considered a synonym of one or both of the other names. The problem which remains to be decided is, which of the available generic names, *Hyridella* or *Propehyridella,* should be used for *australis* Lamarck.

The genus *Propehyridella* presents no nomenclatural problem. It was validly proposed, with a junior synonym of *Unio australis* Lamarck as type species, and that species was correctly identified as *Unio nepeanensis* Conrad. It has been used quite consistently since 1932 for the group which now proves to include *australis* Lamarck, but has never been used for "australis" of most authors, i.e. *Velesunio* sp. Two New Zealand species at least belong in this genus, but *Propehyridella* has never been used by New Zealand authors.

The genus *Hyridella* Swainson however, as Iredale (1934) pointed out, was probably based on a misidentified species. The generic characters given by Swainson were presumably based on his "Unio australis Lamarck" since the genus is monotypic. These characters included, among others, "bosses not sulcated; a posterior margin elevated and winged; one cardinal and one lateral tooth in each valve" and Swainson wrote that "the whole shell has very much the aspect of an Anodon." None of these characters describes *Unio australis* Lamarck. Only one Australian species approaches this description, *Unio wilsonii* Lea 1859, from Central and north Western

Australia, and Swainson may well have had that species before him. However, *U. wilsonii* Lea belongs with the *Velesunioninae,* and in any case there is no way of proving just which species Swainson had, since his material is presumably no longer extant. As Iredale (1934) pointed out, quite possibly Swainson did not have an Australian shell before him.

The correct procedure in handling cases of apparently misidentified type species of genera has been the subject of two opinions of the International Commission on Zoological Nomenclature (Opinions 65 and 168) and was further deliberated upon at the Paris meetings in 1948. The conclusions of the International Commission are set out in the Bulletin of Zoological Nomenclature, 4: 159. If there are grounds for believing that the type species was misidentified, it is recommended that the case be referred to the Commission, whereupon three possible courses of action might be taken. If the species intended as type species by the author can be identified, the Commission could designate that species to be the type species. If the intended species is doubtful, then a species could be designated as type species in conformity with current usage. However, if either of these actions would cause more confusion than uniformity, then the Commission could direct that the nominal species cited by the author of the generic name be accepted as type species.

In the present case, Swainson's material is not available, so that it is impossible to identify his intended type species. Even if this were possible, action by the Commission designating the intended species as type of the genus might not be advisable, since the well known name *Hyridella* might be removed from the Australian fauna, and might cause the displacement of some other well established generic name elsewhere. None the less, it is clearly laid down in principle by the discussion and conclusions of the Commission that credit should be given if possible to the author of a genus for the group which he intended to recognise, and not to some other group simply because of an error in identification.

The possibility of designating a type species in conformity with current usage must be considered. Unfortunately this cannot be done without confusion, since there is no agreement

on the usage of *Hyridella.* For example, current usage in Australia places *Hyridella* with the Velesunioninae as a senior synonym of *Velesunio,* since most Australian workers do not follow Iredale, and still refer to *Velesunio ambiguus* (Philippi) as *Hyridella australis.* To satisfy them, the Commission would have to designate *Unio ambiguus* Philippi as type species of *Hyridella.* However, New Zealand workers, including the latest reviewer, Dell (1953), refer their species to *Hyridella,* and none of these belong to the Velesunioninae. To satisfy their current usage, a Propehyridelline species, such as true *Unio australis* Lamarck would be the most acceptable type species.

It seems quite clear that the application of either of the first two possible Commission rulings would lead to greater confusion than uniformity. Hence the third possibility is the only logical course of action, that is, to ignore Swainson's obvious error, and to redefine the genus in terms of *Unio australis* Lamarck as here determined. This course is chosen for two principal reasons; first because *Hyridella* is associated throughout the world with the Australian freshwater mussel fauna, and particularly with the name *australis* Lamarck. Secondly, because this will preserve the name *Hyridella* for the New Zealand species. It is not proposed to take this problem to the International Commission, since for the reasons outlined above, it is unlikely that the Commission would follow any other course of action than that adopted here.

The subfamily name will have to be changed to Hyridellinae Iredale 1934, and the genus *Propehyridella* Cotton and Gabriel 1932 must be ranked as a junior synonym of *Hyridella* Swainson 1840. The generic characters of *Hyridella* will be those listed by Cotton and Gabriel in their original definition of *Propehyridella,* and not necessarily those of any previous author, including Swainson. The generic characters of *Hyridella* as given by Cotton and Gabriel (1932) must be discarded, and the group known under this name by them will take the name *Velesunio* Iredale 1934 with generic characters as defined by Iredale (1934). The type species of *Velesunio* Iredale is *Unio balonnensis* Conrad 1850, which is a junior synonym of *Unio ambiguus* Philippi 1847. This systematic arrangement is tabulated below:

Subfamily Velesunioninae Iredale 1934

Genus *Velesunio* Iredale 1934 (= *Hyridella* of Cotton and Gabriel 1932) non *Hyridella* Swainson 1840. Type species = *Unio ambiguus* Philippi 1847 (= *U. Balonnensis* Conrad 1850)

Subfamily Hyridellinae Iredale 1934

Genus *Hyridella* Swainson 1840 (emended) (= *Propehyridella* Cotton and Gabriel 1932). Type species = *Unio australis* Lamarck 1819 (= *Unio nepeanensis* Conrad 1850)

Species included in Hyridella: *H. australis* (Lamarck); *H. drapeta* (Iredale) 1934; *H. menziesi* (Gray) 1843, and other New Zealand species.

The main purpose of this paper has been to reveal the true identity of *Unio australis* Lamarck 1819, and to bring to light the facts concerning the genus *Hyridella* Swainson. It is hoped that other workers will agree with the course of procedure suggested here, and that the changes in collections made necessary by the displacement of the name *Hyridella* from the usually accepted group will be outweighed by the advantages of preserving this name for the Australian and New Zealand faunas.

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NEW CONUS FROM COSTA RICA

By JEANNE S. SCHWENGEL

CONUS DRANGAI n. sp. Plate 2, figs. 1, 2, 3, 4, 5, 6, 7.

Shell 32–35 mm. length, 16–20 mm. width; straight sided, sloping to about 6 mm. width at base; strong and solid, with a heavy, dark brown periostracum which almost entirely obscures the color pattern of the shell. Two to two and a half apical whorls, glassy, buff colored; followed by eight or nine revolving body whorls. Color cinnamon to blackish brown, the tip apricot-buff, this color spreading upward on the columnar surface. A wide median band, occupying nearly a third of the outer whorl, white and brown blotched, resembling somewhat

a string of dancing paper dolls; four to six rows of revolving brown dots, which show only on the white blotches; evenly spaced, raised lineations on the body whorl, becoming gradually stronger and closer as they near the base of shell. Lower fifth or sixth of whorl very light buff, turning to apricot color as it nears the inner lip; aperture white.

The spire is thickly blotched with brown and white, giving a somewhat checkered appearance. Definite sutures, whorls unevenly joined; curved growth lines on spire which gives a raised, laminate appearance to the peristracum. A faint suggestion of raised, revolving lines on each whorl of the spire, sometimes clearly defined and then almost disappearing, only to be resumed farther on toward the last whorl. In appreciation of assistance from Dr. Harald A. Rehder, the holotype and one paratype is in the U.S.N.M. Other paratypes are in the collections of Jeanne S. Schwengel and Ted T. Dranga, for whom the shell is named. These shells were collected by Ted and Anna Dranga in 1954 at Bahia Salinas, Costa Rica. Unfortunately no live specimens were collected.

Conus drangai most nearly resembles *Conus vittatus* Bruguière, though considerably smaller; much darker brown; not as neatly and evenly patterned; with no spots on the encircling raised lineations, except over the white areas. The bright apricot tip is constant and very distinctive.

CONUS ANDRANGAE n. sp. Plate 2, figs. 8, 9, 10, 11.

Shell 47 mm. length, 32 mm. width; heavy, straight sided, low spire, each whorl coronated, body whorl having 15 stubby, rounded, white-tipped nodes. Growth lines evident on spire and body whorl. Ground color chestnut brown, splotched with white near the periphery, with a median and basal white band. Entire body whorl encircled with brown lineations which break up into dots and dashes over the white areas, and become raised and slightly nodulous on lower third of shell. Interior of straight sided aperture white, slightly wider at base. Holotype is in U.S.N.M.; paratypes in collections of Jeanne S. Schwengel and Ted T. Dranga. These shells were collected in 1953 at Bahia El Coco, Costa Rica by Ted and Anna Dranga. This species is named for Anna Dranga.

Schwengel: Costa Rican *Conus*.

C. andrangae somewhat resembles *C. brunneus* Wood, but has no lineations on the spire, and the median and basal white bands are constant; the nodes on the spire are more conspicuous and closer together, being placed more nearly as in *C. diadema* Sowerby. The triangular shape is like *C. bartschi* Hanna and Strong, though shorter and wider.

CONUS GRADATUS THAANUMI n. subsp. Plate 2, figs. 12, 13.

Length 47 mm., width 21 mm. Specimens collected by Ted and Anna Dranga are much more slender than *C. regularis* Sowerby, a moderate spire, neither as high as Reeve's illustration of *C. gradatus* Gray nor as flat as *C. regularis* Sowerby. They are marked with the spiral dotted lines, scarcely broken below the center for one faint band, as in *C. scalaris* Valenciennes and with the heavy longitudinal markings of chestnut brown of *C. gradatus* Gray.

Having definite characteristics of so many different species, it would seem to simplify the assorting of the several varieties which are found in Lower California, if this shell were given the sub-specific name above, to honor Mr. D. D. Thaanum, a dear friend of Ted Dranga, and a great collector of conus.

These specimens were collected in 1954 at Bahia Salinas, Costa Rica.

CONUS RECURVUS HELENAE n. subsp. Plate 2, figs. 14, 15.

Length 44 mm., width 18 mm. This shell is quite slender, a high spire, with slightly rounded shoulder, and no bands of white, though nearer to *C. recurvus* Broderip than any other named species. Beginning below center of body whorl are deep spiral lineations, which do not seem to be mentioned in any of the descriptions of *C. recurvus* Broderip in the various books. Whether this should be a new species or only a sub-species is in doubt, but we suggest a sub-specific name until numerous live specimens may be obtained, at which time the study of this shell should be pursued.

These specimens were collected in Curu, Gulf of Nicoya, Costa Rica by Ted Dranga in 1952, and are named for his mother.

ADDITIONAL LOCALITIES FOR LAND MOLLUSCA IN OKLAHOMA

By DEE SAUNDERS DUNDEE

University of Michigan

Land mollusks have now been reported from 65 of Oklahoma's 77 counties. The total number of species (exclusive of their subspecies, varieties and forms) reported so far is 81.

Oklahoma is an interesting state from an ecological standpoint in that ten biotic districts (Blair and Hubbell, 1938) exist within it. A deciduous forest element in the eastern part of the state, a large area of grassland of the Great Plains extending from north to south through the central portion, and a southern Rocky Mountain district in the extreme west are the three principal subdivisions of the state. Elevations range from 350 feet in the Mississippi biotic district (a portion of the Gulf Coastal Plain) to 4,500 feet in the Mesa de Maya district of the west. The western portion of the state, largely open plains, is drier and cooler than the rather heavily forested eastern part. Annual precipitation ranges from 17 inches in the panhandle to 50 inches in McCurtain County of the extreme southeast.

It is the purpose of this paper to make additions to the growing list of mollusks of Oklahoma so that the fauna will soon be known. Only then can we correlate the distributions with data such as those given above. Following the pattern set by Lutz (1949), and adopted by Wallen (1951) and Wallen and Dunlap (1954), only county names will be given here even though exact locality data are available.

The specimens comprising this list have been collected over the past three years by Harold Dundee and myself. Some of these have been deposited in the U. S. National Museum and the remainder will be placed in the collection of the Museum of Zoology, University of Michigan.

Thanks are due Dr. J. P. E. Morrison of the U. S. National Museum for checking identifications of many of the species and to Dr. Henry van der Schalie of the Univ. of Michigan for reading the manuscript.

Polygyra leporina (Gould) 1848. Wagoner, Mayes, Bryan

Polygyra texasiana (Moricand) 1833. Rogers, Mayes, Hughes

Polygyra dorfeuilliana Lea 1838. Choctaw

Polygyra dorfeuilliana sampsoni Wetherby 1881. Adair, Cherokee, Sequoyah, Murray, Osage, McCurtain, Bryan, Coal

Stenotrema labrosum (Bland) 1862. Adair, McCurtain

Stenotrema monodon aliciae (Pilsbry) 1893. Adair, Cherokee, Rogers, Delaware, Coal, Hughes

Mesodon thyroidus (Say) 1816. Adair

Mesodon thyroidus bucculenta (Gould) 1848. Adair, Choctaw

Mesodon clausus (Say) 1821. Adair

Mesodon indianorum (Pilsbry) 1899. Latimer, Rogers

Mesodon binneyanus (Pilsbry) 1899. McCurtain, Latimer

Mesodon kiowaensis (Simpson) 1888. Choctaw-McCurtain County line

Mesodon inflectus (Say) 1821. Adair, Sequoyah, Mayes, Delaware, Choctaw

Triodopsis cragini Call 1886. LeFlore, Mayes, Coal, Okmulgee, Hughes, Latimer

Triodopsis albolabris alleni (Wetherby) 1883. Mayes, Delaware, McCurtain

Triodopsis divesta (Gould) 1851. Adair, Latimer

Bulimulus dealbatus (Say) 1821. Cherokee, Sequoyah, Tulsa, Mayes, Choctaw, Bryan

Retinella indentata paucilirata (Morelet) 1851. Murray, Cleveland, LeFlore, Mayes, Bryan, Coal Okmulgee, Latimer

Mesomphix friabilis (W. G. Binney) 1857. Adair, Sequoyah, McCurtain

Mesomphix cupreus ozarkensis (Pilsbry and Ferriss) 1906. Adair, LeFlore

Ventridens brittsi (Pilsbry) 1892. Adair

Zonitoides arboreus (Say) 1816. Adair, Coal, Okmulgee, Hughes

Limax flavus Linnaeus 1758. McCurtain

Deroceras sp. Delaware

Hawaiia minuscula (Binney) 1840. Latimer

Anguispira alternata crassa Walker 1928. Sequoyah, Delaware, McCurtain

Philomycus carolinianus (Bosc) 1802. Delaware, McCurtain, McCurtain-Choctaw County line

Helicodiscus parallelus (Say) 1817. Okmulgee

Succinea grosvenori Lea 1864. Murray, Hughes

Strobilops texasiana (Pilsbry and Ferriss) 1906. Murray, Tulsa, Bryan, Okmulgee, Hughes, Latimer

Gastrocopta armifera (Say) 1821. Sequoyah, Mayes, Bryan, Latimer

Gastrocopta contracta (Say) 1822. Mayes, Bryan

Gastrocopta procera (Gould) 1840. Bryan

Pupoides albilabris (C. B. Adams) 1841. Mayes, Hughes, Latimer

Oligyra orbiculata tropica Pfeiffer 1852. Sequoyah, Bryan

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SHELLS COLLECTED AT LOUGHBOROUGH LAKE, ONTARIO, IN JULY

By Dr. and Mrs. W. A. SWANKER

Loughborough Lake is one of the numerous Rideau Lakes Group which are to be found in Ontario, north of Kingston. The southernmost of these lakes is Loughborough which extends in northeasterly direction from a point a little west and some 20 miles north of Kingston. It is about 22 miles long and from one-half to three-quarters of a mile wide. As it empties into others of the Rideau Lake system, it is a part of the St. Lawrence water shed.

The lake has numerous shallow mud-bottomed flats which have a good growth of aquatic plants. It is here that shell collecting is at its best. Most of the types listed below are seen in quantity. The unios were the most widely recognized as they were only partly buried in the mud among the sparcer areas of vegetation. There were quantities of dead shells everywhere. Among the dead shells, which seemed to be grouped as though they had been swept together here and there, the first of the *Planorbis* and *Lymnaea* were found. These dead shells stimulated the search and soon several specimens of the living snails were collected. Some were found on the bottom detritis while many of the *Planorbis* were found feeding on the aquatic vegetation.

Three stations were selected at or near the southern extremity of the lake.

Station No. 1: Nearest the tip, it had a shale shore which rose from the water edge a few feet, extended back from the water about 30 to 50 feet and then rose sharply to a high hill. The bed of the lake at this station was covered with small stones, decaying logs and aquatic vegetation out to 15–20 feet where it gave way to a soft mucky ooze covered by a thick carpet of vegetation. The water depth sloped slowly to 4 feet about 100 feet off shore. The species found there were:

Lymnaea stagnalis Linnaeus; numerous dead and several living shells.

Planorbis trivolvis Say; few dead and numerous living shells.

Elliptio complanatus Dillwyn; many valves and few pairs, no living.

Anodonta marginata Say; few valves, 1 pair, no living.

Station No. 2: Along the eastern shore of the lake about 2 miles from the first station, it had a gravelly shore line with a low well wooded background. The bed of the lake here was a more sandy type of mud, more sparsely covered with aquatic vegetation in which there were areas of the bottom free of any vegetation. The water depth was slight as this great submerged flat extended out 300 feet with water reaching only about 18″ and then dropping off rapidly to a considerable depth. The species found at this station were:

Lymnaea stagnalis Limnaeus; numerous living and dead shells.
Planorbis trivolvis Say; numerous living and dead shells.
Elliptio complanatus Dillwyn; numerous living and dead shells.
Anodonta marginata Say; many living, occasional valve.
Lampsilis luteolus Lamarck; occasional shells.
Lampsilis siliquoidea Barns; 1 pair of valves.
Sphaerium sulcatum var. *insigne;* 1 pair and 2 valves.

Station No. 3: Along the western shore about 2 miles from the first station, there was a broad meadow that made a low shoreline that was of a clayish gravelly nature. The slope of the bed of the lake was much more acute, reaching a depth of 10 feet only about 25 feet from the shore. The aquatic vegetation was very sparse and consisted of small thin clumps here and there. An occasional damaged old valve of a *Unio* was found near the water's edge along with one or two old mud filled *Lymnaea* shells. A few living *Planorbis* were found on the vegetation. The absence of shell life was most striking when one considers the abundance of mollusks across the lake only ¾ of a mile away (Station No. 2).

These specimens collected were housed in the shell collection of the American Museum of Natural History in New York.

HOW CLAM DRILLS CAPTURE RAZOR CLAMS

By HARRY J. TURNER, JR. *

During the past few years, the author has observed a number of instances of predation by the carnivorous marine snail, *Polinices duplicatus,* on the razor clam, *Ensis directus.* In every case, the snail and the razor clam were found on the surface of the substratum with the clam enveloped in a coating of slime and the snail attached along the mid-ventral region with its proboscis inserted between the valves. No drilled razor clam shells have ever been found.

* Contribution No. 777 from the Woods Hole Oceanographic Institution.

It is difficult to imagine how *P. duplicatus* can capture a razor clam and hold it long enough to render it inactive, because razor clams normally retreat to considerable depths when disturbed. Burrowing is accomplished by extending the foot downward, expanding the distal portion as an anchor, and pulling the body down by strong contractions of the proximal portion of the foot. The process is then repeated so rapidly that a depth of ten inches can be reached in a matter of seconds and the force of the contractions is so great that the foot and part of the viscera may be torn out if the shells of a burrowing razor clam are held to prevent them from following the foot.

Recently, the author had the good fortune to make some observations on an attack by *P. duplicatus* on a razor clam which gave some indications as to how the snail may immobilize its prey. A 97 mm razor clam was found on the surface of the sand with a 15 mm snail attached to the posterior end. The clam was extending and retracting its foot in writhing motions as if making an attempt to escape. The clam finally managed to work its foot down into the sand, pull itself into an erect position, and begin to burrow. As soon as the clam had erected itself, the snail quickly crawled down the body and burrowed into the sand along side of its prey. The razor clam continued to dig in until ⅔ of its length was buried and then stopped.

After a two-minute period the razor clam suddenly forced its way out of the sand with violent thrusts of its foot. The snail was attached to the lower third of the body but the final thrust detached it. The razor clam immediately extended its foot and began to burrow, touching the snail as it did so. The snail then dug in along side of the clam which again stopped as soon as ⅔ of its length was buried. The clam made one or two feeble attempts at digging in deeper. The posterior end was just level with the surface when it suddenly forced its way out again with the snail attached to the lower portion. The last motions detached the snail and thrust it a few centimeters away from the clam. The clam and the snail then dug in independently although the activity of the clam was much slower than during the early part of the encounter.

No further activity was observed for the next ten minutes. The razor clam and the snail were then dug up and found to be

separated from each other by five centimeters. The snail was expanded with its head oriented away from the clam. When placed on the sand, the clam showed no activity during the next 30 minutes after which observations were discontinued. All but the lower (anterior) end of the body of the clam was covered by an envelope of slime secreted by the foot of the snail.

It seems clear that *P. duplicatus* captures *Ensis directus* by approaching it below the surface of the substratum and by irritating the lower portion so that it retreats upward. The snail then coats the razor clam with an envelope of slime which appears to have anesthetic properties. Successful capture probably depends on the ability of the snail to maintain contact with its prey until anesthesia takes place.

ON THE OCCURRENCE OF THE NUDIBRANCH ALDERIA MODESTA (LOVÉN, 1844) ON THE CENTRAL CALIFORNIAN COAST

By CADET HAND and JOAN STEINBERG

Department of Zoology, University of California, Berkeley

Alderia modesta (Lovén, 1844) has long been known from the coasts of northern Europe. It has been recorded from as far north as the Trondheim Fjord in Norway (Norman, 1893), south to Skibbereen in Ireland (Allman, 1845) and on the French coast (Gollien, 1929). Therefore, it has been of considerable interest to us to find well-established populations of an *Alderia* in two localities on the central Californian coast. Through the kindness of Monsieur G. Van Put of the Royal Institute of Natural Sciences of Belgium in Brussels and Dr. Erik Rasmussen of the Royal Veterinary and Agricultural College in Copenhagen, we have been able to compare specimens of *Alderia modesta* from both Belgium and Denmark with specimens collected by us from the California localities. The results of these comparisons have shown the *Alderia* from California to be identical with *A. modesta.*

Alderia Allman, 1845

Alderia Thompson, W. (nomen nudum), 1844, Rep. Brit. Assoc. Adv. Sci. for 1843, p. 250.
Alderia Alder, J., and A. Hancock (nomen nudum), 1845, Rep. Brit. Assoc. Adv. Sci. for 1844, p. 26.
Alderia Allman, G. J., 1845, Rep. Brit. Assoc. Adv. Sci. for 1844; Trans. of the Sections, p. 65.
Aldena (error pro *Alderia* Allman, 1845) Paetel, 1875, Fam. Gatt. Moll *6*.
Type by subsequent designation: *Stiliger modestus* Lovén, 1844.

Alderia modesta (Lovén, 1844)

Stiliger modestus Lovén, 1844, Ofvers K. Vetensk.-Akad. Forhandl. Stockholm *1*(3), p. 49.
Alderia amphibia Thompson, W., 1844 nomen nudum, Rep. Brit. Assoc. Adv. Sci. for 1843, p. 250; Alder, J., and A. Hancock, 1845, nomen nudum Rep. Brit. Assoc. Adv. Sci. for 1844, p. 26.
Alderia modesta Allman, 1846, Ann and Mag. Nat. Hist., ser. 1, *17*, p. 5; Lovén, 1846, Ofvers K. Vetensk.-Akad. Forhandl. Stockholm, p. 8.
Alderia scaldiana Nyst, 1855, Bull. de l'Acad. de Belgique XXII, no. 2, pp. 435–37, figs. 1, 2.

Diagnosis.—*Alderia:* Body elongate and elliptical. Head without rhinophores but produced into rounded lobes on either side of median line; mouth a vertical slit; eyes visible through integument behind lobes. Foot nearly straight anteriorly, bluntly tapered posteriorly; lateral margins wider than body. Groove laterally between body and foot. Cerata cylindrical, bluntly pointed apically; arranged longitudinally on either side of posterior three-quarters of body and roughly divisible into 3–5 rows set obliquely to longitudinal axis of body; number of cerata variable, maximum 15–16 on a side, often fewer. Anus on free tube located posteriorly in median line. Genital pores situated below first cerata on right side. General ground color translucent yellowish white; dorsum and cerata speckled with numerous black pigment spots; cephalic lobes and anterior dorsal region often heavily pigmented; anterior edges of cephalic lobes lacking pigment, unpigmented area sometimes extending back to region of eyes as a colorless line; cerata with a few opaque white dots, especially apically. The animals sometimes appear green because of the color of food present in the highly ramified digestive diverticula.

Jaws absent. Radula uniserial with 11–14 spoon-shaped teeth and sac containing discarded teeth at base; a single tooth measur-

ing 120 μ with a base of 40 μ (Fig. 1). Penis bearing single large spine 180 μ in length (Fig. 2).

The largest specimens collected measured 8 mm. in length. One of average size measured 5.5 mm. in length, 1.2 mm. in height and 2 mm. in breadth (Fig. 3).

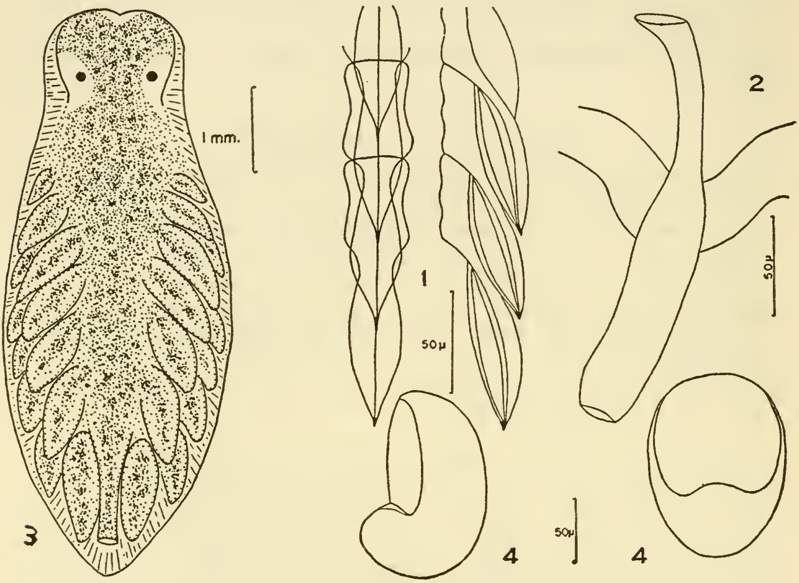

FIGURE 1. Top and side views of a portion of the radula of *Alderia modesta.* FIGURE 2. The penial spine of *Alderia modesta.* FIGURE 3. *Alderia modesta* (Lovén). FIGURE 4. Larval shell of *Alderia modesta.*

OCCURRENCE: Type locality: Bohuslan, Sweden (Loven, 1844). Other localities: northern and central Europe. New localities: (1) Bay Farm Island, Alameda Co., California, on *Vaucheria* sp. in a *Salicornia* marsh bordering San Francisco Bay in area wetted only by high tides, May, July, August, 1951 and March, 1954; with various ciliates, diatoms, nematodes, fly larvae, mites, small oligochaetes, harpacticoid copepods, amphipods. (2) Elkhorn Slough, Monterey Co., California, in *Salicornia* marsh on *Vaucheria* sp., August, 1951; July, 1952; with *Cerithidea* and *Phytia.*

Discussion: The eggs of *Alderia modesta* are laid in round to elongate masses measuring about 5.5 mm. in length and 1.5 mm. in diameter. These masses are anchored at one end to the substrate and consist of an irregular coil of egg capsules embedded in a soft gelatinous matrix. The coil is about 200 μ wide. The capsules measure 150–180 μ in diameter and each contains a single egg measuring 70–80 μ in diameter. The capsules may be so closely packed together in the coil that many assume a polyhedral shape. The color of the eggs is yellowish when laid but changes to white as development proceeds. The veligers have been described by Rasmussen (1951), and ours appear to be quite similar. The larval shell is bowl shaped with only a suggestion of a whorl. A shell measured 124 μ in length and 88μ in width (Fig. 4). There are no pigment spots on the veligers.

Insemination has been observed several times and is accomplished by hypodermic injection. During copulation persistalic waves move along the extended penis and a flow of seminal material can be seen entering the recipient *Alderia*. Injection can apparently occur at any point on the body, and after copulation the body spaces, including those of the cerata, can be observed to be full of sperm.

Copulation was not observed to be reciprocal nor was there any indication of self-fertilization. Sperm were recovered from a recipient *Alderia* after copulation and were found to be very active. The sperm appear to have a spiral head (approx. 60 μ long) and a tail piece (approx. 45 μ long), but no middle piece could be distinguished.

On August 14, 1951 collections at Elkhorn Slough revealed many egg masses as well as four juvenile specimens, each about one millimeter long and having only a single pair of cerata with the anus located between. Others, about ½ millimeter long, were found without cerata and with the shell still present. At this time an adult pair were observed copulating. One of the individuals injected the sperm into the fourth ceras on the right side of the other.

The animals, for the most part, are confined in their distribution to *Vaucheria* sp. which forms dark green mats on the mud. Other mats of algae, lighter green in color, generally support no

Alderia. These mats consist of a Cladophoracean (either *Rhizoclonium* or *Urospora*), *Oscillatoria* and *Enteromorpha*. The food of *Alderia* seems to consist entirely of *Vaucheria* on which it actively grazes.

An interesting characteristic of *Alderia* is a peculiar sickly sweet smell which is especially noticeable after a group of animals have been confined to a jar for some time. Another characteristic of the live animals is that the body surface, including the cerata, possesses many scattered ciliated cells. These cells appear to be effective in moving the film of water present on the algal substrate over the body of the animal, thus keeping the *Alderia* continuously wet in what approximates a terrestrial habitat. Still another characteristic of *Alderia* is that the cerata exhibit a rhythmic contraction which alternates from one side to the other. There are no anterior-posterior differences in the time of contraction.

Two other species ascribed to the genus *Alderia* have been reported from the Pacific Basin. One, *Alderia? albopapillosa* Dall, 1872, has been shown by Bergh (1880) to belong to the phanerobranchiate genus *Adalaria* Bergh. The other, *Alderia nigra* Baba, 1937, possesses distinct rhinophores, a character which excludes it from the genus *Alderia*. *Alderia harvardiensis* Gould and Binney, 1870, which was collected by A. Agassiz (1851) in the Charles River and the creeks around Cambridge, Massachusetts and by W. Stimpson (1853) in the region around the mouth of the Bay of Fundy, New Brunswick, is distinguishable from *A. modesta* only in the form of the anterior margin which appears in Agassiz's drawing (in Gould and Binney, 1870) to be concave rather than bilobed and in the darker coloration. There is, in the U. S. National Museum, a single specimen of *A. harvardiensis*. Through the kindness of Dr. Rehder this specimen has been examined by one of us (Steinberg), although no decision as to its real identity could be made. The specimen is in very poor condition and the anterior end has been damaged and the radula removed. From the form of the body which is still clear the specimen looked suspiciously like a small *A. modesta*. This species has not been recorded since the last century, but, if further material becomes available, it appears quite possible that *A. harvardiensis* may actually be *A. modesta*.

Acknowledgments.—We gratefully acknowledge the kind help of Dr. Isabella Abbott for the identifications of the several genera of algae mentioned in the text, and Mrs. Lois Stone for the preparation of the figures.

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SOME ECOLOGICAL ASPECTS OF THE NAIAD FAUNA OF LAKE SPRINGFIELD, ILLINOIS

By PAUL W. PARMALEE

Lake Springfield, which is approximately 2 miles south and east of Springfield, Sangamon County, underwent construction in 1931 and was completed in May of 1935. The lake has a surface area of 6.8 square miles; there is approximately 57 miles of shoreline, 40 of which has been riprapped. By riprapping (placing broken stone or rock along the lake edge) much of the shoreline, silting resulting from eroded banks and bordering fields has been reduced to a minimum. The lake was formed by the damming of Sugar Creek, a small, relatively shallow, muddy creek that presently has little or no effect in feeding Lake Springfield with renewed water supplies. Lake Springfield is approximately 12 miles in length with a maximum width of two miles. Maximum depth is about 40 feet; average depth, 15 feet. Except for some emerging vegetation, there is little or no submerged or floating aquatic vegetation in most parts of the lake.

The year 1953 was one of below-average rainfall for Illinois and there was 12–14 inches less precipitation than during normal years. Because of this reduced precipitation and the continued use of the lake as a source of water by the city of Springfield, the water level dropped approximately seven feet during 1953. The gradual receding of the water left most of the shallow bays and inlets dry, and thereby exposing much of the mussel fauna of these areas to desiccation.

During October, 1953, an attempt was made to determine the species composition and relative abundance of the Lake Spring-

field mussels. This lake presented an interesting study since (1) the effects on a mussel population by damming and thereby changing the physiographic condition of a natural creek could be observed; (2) it was possible to note the influence of bottom types on distribution and abundance, and (3) the species composition and relative abundance could be studied in this somewhat limited area.

Twenty sites or stations (Fig. 1), including the various bottom types, were sampled. At each site, all mussel shells were removed within a space approximately 50 yards long and four yards wide. The abundance of dead shells and partially or almost wholly buried individuals at the water's edge would tend to show their inability as a whole to retreat with the receding water. Although this distance varied slightly at some sites, an effort was made to keep the area covered at all stations equal in size. Numerous other localities were examined for the purpose of locating species not found at the other sites, but no additional species were discovered.

Unfortunately there are no early studies of the mussel fauna of Sugar Creek and other neighboring streams and rivers, so that comparisons of naiad populations in the lake with these creeks and rivers must be based on current observations. In addition, there have been numerous fish-stocking programs since the completion of the lake in 1935, and these introduced fish could carry glochidia and hence introduce and possibly establish certain species.

The bottom types can arbitrarily be divided into either coarse gravel and rock (riprap), a mixture of mud and sand, or mud, the latter constituting a large percentage of the bottom surface of the more sheltered bays and inlets. It is of interest to note that portions of the lake bottom consisting of rock and gravel, and sand in some cases, are often almost devoid of mussels. For example, the shoreline in front of Spaulding Dam (Station I) and the Dividing Dam (Station II), as well as Lake Park (Station VI), is mostly rock fill and gravel, and the mussel population in these areas is low in both abundance and number of different species. Such areas of coarse gravel and rock bottom are in themselves generally unsuitable for habitation by the mussels, although these portions of the lake are more exposed

to the prevailing winds and consequently a more severe wave action results. A combination of less suitable bottom habitat (conditioned in part by wave action) and frequently turbulent waters would tend to inhibit the growth of naiad populations in such situations. The mud-sand bottom, formerly covered by water to a depth of two to four feet, appeared to have provided the most suitable habitat for these animals, and in such areas the mussel fauna of Lake Springfield reached its greatest abundance, both numerically and in numbers of species.

The majority of species now found in the lake were probably present in Sugar Creek before it was dammed. These species are also present in the Sangamon River and the South Fork of the Sangamon. Other species such as *Tritogonia verrucosa, Quadrula pustulosa, Obliquaria reflexa, Megalonaias gigantea, Truncilla truncata,* and *Leptodea fragilis,* common in the South Fork of the Sangamon River (which flows at one point within approximately half a mile of Lake Springfield), are absent from the lake. If these, and possibly other stream or river species, were ever present in Sugar Creek, they apparently were not able to adjust to lake conditions after the creek was dammed. Van der Schalie (1938) mentions the occurrence of *T. truncata* in Lake Erie and Brown, Clark and Gleissner (1938) refer to Lake Erie specimens of *Leptodea fragilis.* However, the ability of such river species to adjust to lake conditions in one instance and not another may be the result of differences in size of the body of water, the influence of current or the absence or abundance of the regular host fish of the glochidia.

Normally *M. gigantea, T. truncata* and other species that are adapted primarily to moving bodies of water would not be expected in a lake environment. However, the common Mapleleaf (*Quadrula quadrula*), a species also found typically in larger rivers and streams, has become well adapted to a lake habitat and constitutes over 45% of the total number of mussels in Lake Springfield (Table 1). It is the most abundant species and can be found in all parts of the lake. *Amblema costata,* primarily a species of medium-sized rivers, is also present in the lake but in relatively small numbers. The predominating mud bottom may limit the abundance of this species in the lake since it appears to prefer a sand or gravel bottom, although it

was found to be most numerous in mud (Station XV) where Lick Creek enters the lake.

In this connection it is of special interest to note the situation encountered at Lake Decatur, a man-made lake lying immediately southeast of the city of Decatur (approximately 45 miles east of Springfield), Macon County, Illinois. This lake is somewhat smaller and generally more narrow than Lake Springfield, and it is fed directly by the Sangamon River. Much of the bottom consists of a mixture of sand and mud, and at one point approximately ½ mile from the dam, large colonies of *Truncilla truncata, Quadrula quadrula, Q. pustulosa, Carunculina parva* and *Fusconaia flava* have become well established in three to four feet of water. In comparison, *Arcidens confragosus* and *Amblema costata* are uncommon, but this particular situation illustrates the adaptive ability of river forms to lake conditions. Although *F. flava* has been recorded as part of the Lake Erie fauna (Brown, Clark and Gleissner, 1938), it apparently becomes abundant only in rivers and in lakes (such as Lake Decatur) that are influenced by river current. The occurrence of river species such as *F. flava, Quadrula quadrula, Q. pustulosa* and *T. truncata* would tend to verify the fact that Lake Decatur is a river-lake, defined by Coker as "a body of relatively still water as would ordinarily be called a lake, which is yet intimately connected with a river, either as interpolated in the course of the river, or as an arm of a river" (van der Schalie, 1938). Such river species would be expected in Lake Decatur where river-lake conditions exist. It is reasonable to assume that the almost complete lack of current influence in Lake Springfield has inhibited the establishment of river mussel populations, *Quadrula quadrula* being the one notable exception.

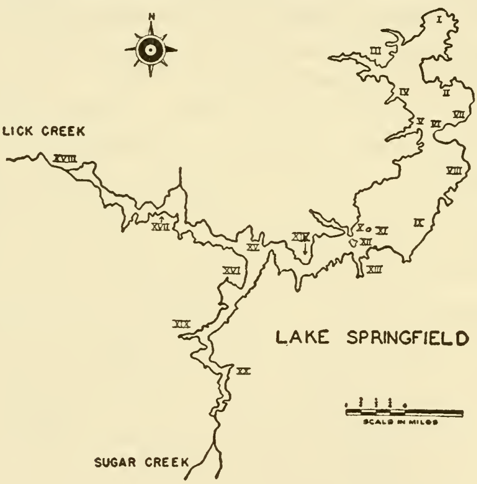
In Lake Springfield *Anodonta grandis* is widely distributed but it is generally not common anywhere. It was found at a variety of depths up to about six feet, in either a sand or mud bottom or a combination of both, but preferably sand. *Anodonta imbecilis,* although also distributed throughout the lake, is relatively rare and is limited to those shallow bays and inlets with a soft, black mud bottom.

Leptodea laevissima, the Fragile Heel-Splitter, is the second most abundant species in the lake, constituting approximately

Table 1. The Species Composition, Distribution, and Relative Abundance of the mussels of Lake Springfield, Illinois.

STATIONS

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	Total No. of each Species	% of Total Population
Quadrula quadrula	17		26	26	28	4	78	25	20	12	33	26	21	16		25	14	30	54	17	472	47.81
Anodonta grandis	1		7	9	1		8	5	1	4	1		4	3		2	1	3	12	1	63	6.38
Anodonta imbecilis				2						1			1	1	1	1					7	.70
Lasmigona complanata			11	8	5		3	10	3	16		5	3	12	8	9	3		13	4	111	11.24
Leptodea laevissima		3	15	18	12	3	6	10	8	29	5	21	2	13	7	13	13	5	21	9	213	21.57
Ligumia subrostrata		2	25	17	6	9	1	2	4	5	6	5	3	4	10			1		5	105	10.63
Amblema costata			1	1				2				2			6	2					14	1.41
Arcidens confragosus												1									1	.10
Fusconaia flava										1											1	.10
Totals			x																		987	99.94



22% of the total population. This species is usually found in large rivers on sand and mud bottom in good current (Baker, 1928) but, as in the case *Q. quadrula,* it can adapt itself to lake conditions and has become quite numerous and widespread in Lake Springfield. The adaptation of river species to a true lake habitat is unusual although van der Schalie (1936) found such a situation in the case of *Lampsilis ventricosa* and *Strophitus rugosus* in a small lake in southern Michigan. The White Heel-Splitter (*Lasmigona complanata*), a species typical of the quiet

waters of rivers and creeks, is also quite common. In the lake, both species of heel-splitters reach their greatest abundance in the mud bottoms of shallow (one to three feet) bays and inlets.

Ligumia subrostrata ranked fourth in abundance and, like most species in the lake, becomes most numerous in the shallow, mud bottom regions. It is often found in the quiet backwaters and sloughs of rivers, so that the prevailing physiographic conditions of Lake Springfield provide a comparable habitat. Only one specimen (an adult) of *Arcidens confragosus* was found and therefore it should be considered as accidental or stray and not part of the permanent population. It is normally found in rivers and streams (occurring in the Sangamon River) and does not ordinarily inhabit quiet waters. However *A. confragosus* is never common when it is found in Illinois. Representatives of the Sphaeriidae were found at only one location in the lake (Station 3), a shallow, mud bottom inlet. Apparently little is known concerning their means of distribution.

Summary

Lake Springfield is one of the largest man-made impoundments in Illinois; its surface area is almost seven square miles. The lake has an average depth of 15 feet, and most of the bottom is composed of a black, soft mud.

During 1953 the lake level dropped approximately seven feet, exposing most of the shallow bays and inlets. In October, 1953, an attempt was made to determine the species composition and relative abundance of the mussels by collecting them within a comparable measured area at 20 sites or stations along the lake shore. Although only nine species of naiads were encountered (excluding the Sphaeriidae), several, especially *Quadrula quadrula* and *Leptodea laevissima,* were exceedingly abundant. These two species are of particular interest since in Illinois they are normally found in streams and rivers, but in this instance they have very successfully adapted themselves to a lake no longer influenced by current.

Protected bays and inlets (two to four feet in depth), having a bottom surface composed of soft, black mud and/or sand,

provided the most suitable habitat for the majority of species and in such areas they reached their greatest abundance.

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Van der Schalie, Henry, 1936, An unusual naiad fauna of a southern Michigan lake. Amer. Mid. Nat., Vol. 17, No. 3, pp. 626–628.

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NOTES AND NEWS

Dates of The Nautilus.—Vol. 68, no. 1, pp. 1–36, pl. 1, was mailed July 24, 1954. No. 2, pp. 37–72, pl. 2, Nov. 15, 1954. No. 3, pp. 73–108, pl. 3, Feb. 11, 1955. No. 4, pp. 108–144, i–v, pl. 4, April 28, 1955.—H. B. B.

Discus macclintocki (F. C. Baker), I have finally found living at Bixby State Park, Clayton Co., Iowa. In this park is a cave from which a continuous blast of cold air (temperature about 50° F.) issues. The shells were found in pockets of leaves and moss in crevices from which the cold air blows.—Leslie Hubricht.

The St. Petersburg Shell Club held their annual Shell Show in the Rod and Gun Clubhouse on March 5th to 9th. The Smithsonian Institution award was given to James R. Kelley and Mrs. J. F. Kelley.

The twenty-first annual meeting of the American Malacological Union will be held from July 26th to 29th at Wagner College, Staten Island, New York. Details will be mailed to members as soon as available.—Margaret C. Teskey, Secretary.

Change of address: for American Malacological Union and Margaret C. Teskey.

Old address: 144 Harlem Ave., Buffalo 24, N. Y. New address: Buffalo Museum of Science, Humboldt Parkway, Buffalo 11, N. Y.

Spirula spirula Linné, a remarkable find.—While it is not at all unusual to find these fragile coiled shells cast up upon the beaches of Florida, little is known of the small squid-like creature which forms the shell beyond the fact that it lives at great depths and is world-wide in distribution. It is presumed that the graceful white shell floats to the surface after the squid's life is ended, then being extremely light with numerous gas-filled chambers the dainty shell drifts with the sea-currents until some of them are washed high and dry among the seaweed on our beaches. Apparently most remain at the surface for a considerable time for colonies of small goose barnacles are oftener than not found attached to the shells. The late winter of 1954 was a rather stormy one and it was in December that Mrs. Elizabeth B. Phelps discovered one of these interesting deep sea creatures which had just washed up on the shore at Boynton Beach. The squid was in excellent condition, an adult over 50 mm. in length, with the shell partly visible within the animal. To my knowledge, this is the first record for this squid-like creature having been found in Florida. This unique specimen has been donated to the Academy of Natural Sciences in Philadelphia.—Thomas L. McGinty.

Extension of known range of the slug *Pallifera fosteri* F. C. Baker.—In my paper on the "Distribution of the mollusks in a basic bog lake and its margins" (Nautilus 64(1): 19–26, 1950), I reported a specimen of *Pallifera* collected on the shore of a glacial bog lake in Portage County of northeastern Ohio. Since publication this specimen has been identified by Dr. C. Bruce Lee, Materials Laboratory, Detroit Arsenal, as *Pallifera fosteri* F. C. Baker 1939, confirming the belief of the writer who did not want to put the name in print until checked by a specialist on the group. The species was described by Baker from specimens collected in Vermilion County, Illinois, and additional specimens were collected from Monroe and Wayne Counties (Fieldbook of Illinois Land Snails). H. A. Pilsbry's

monograph of the "Land Mollusca of North America" (Vol. II, part 2) also lists St. Louis Co., Missouri, attributed to Leslie Hubricht. The known range is now extended from eastern Missouri and central Illinois to northeastern Ohio.—RALPH W. DEXTER, Dept. of Biology, Kent State University, Kent, Ohio.

PUBLICATIONS RECEIVED

HOW TO COLLECT SHELLS. A symposium by members of the American Malacological Union. 75 pp. A.M.U., Buffalo Museum of Science, Buffalo 11, N. Y. $1.00. 1955.—This handsome and inexpensive booklet contains a wealth of information on how to collect, dredge, trap and clean marine, land and freshwater mollusks. There are two dozen chapters by well-known American collectors, and both the novice and the experienced will find this attractive manual extremely useful. Also included are lists of useful books, shell clubs and outstanding American mollusk collections. Mrs. Margaret C. Teskey, who is largely responsible for assembling and editing the material, is to be congratulated for what will doubtlessly be a very popular publication—R. T. ABBOTT.

MARINE SHELLS OF THE WESTERN COAST OF FLORIDA. By Louise M. Perry and Jeanne S. Schwengel. 198 pp., 55 pls. Paleontological Research Institution, Ithaca, N. Y. $7.00. 1955.—Fifteen years ago, Dr. Louise M. Perry published her "Marine Shells of the Southeast Coast of Florida" which soon became the most popular of the several books written about the marine mollusks of Florida. It has now been revised and somewhat expanded by Dr. Jeanne S. Schwengel. The eleven additional plates include drawings of the egg capsules and veligers of 24 gastropods, a noteworthy addition to the knowledge of the life histories of our Western Atlantic species. The revisor, perhaps wisely, has avoided using the "common" names of the Florida shells. The photographs are excellent, and "shellers" along the west coast of Florida should find this new edition very helpful.—R. TUCKER ABBOTT.

THE NAUTILUS

Vol. 69 OCTOBER, 1955 No. 2

THE PROPOSED INTRODUCTION OF PREDATORY SNAILS INTO CALIFORNIA

By ALBERT R. MEAD

University of Arizona

Largely through the fact that there has been a great deal of publicity on the subject, a surprising number of people know that a small predatory snail from East Africa has been enlisted in Man's fight against the giant African snail, *Achatina fulica* Bowdich. This predatory snail, *Gonaxis kibweziensis* (E. A. Smith), at present is scheduled to invade new areas at a rate that may well outstrip the records set by its prey. One thing is different. Man *wants Gonaxis* to spread. Or, more exactly, those in charge of the proposed biological control program *want* it to spread. Here is the story.

The small island of Agiguan, off the coast of Tinian in the Marianas Islands, has for five years been the scene of an experimental battle between the giant snail and the predatory snail. Even before the first phase of the battle was over, *Gonaxis* was released in Oahu of the Hawaiian Islands, and later in Guam and Maui in the hopes that it would help control the giant snail. A seventh expedition to Agiguan in October of 1955 has been planned to assist in spreading *Gonaxis* still further. Reportedly, the mission is to collect as many live *Gonaxis* as possible with the plan that one portion is to go to Hawaii for further releases on Oahu and Maui; a second portion is to go to the Trust Territory of the Pacific Islands for release on other infested islands, such as Saipan, Rota, and Truk; and a third portion is to go to California under the tentative plan to use it against the green snail (*Helix aperta*) in the San Diego area, and against the brown snail (*Helix aspersa*) especially in the citrus groves of southern California.

The announcement that it is to be introduced into California will come as a surprise to many, especially in view of the "anti-snail" legislation enacted by Congress only a relatively few months ago. If the Secretary of Agriculture, who has promulgated the required protective regulations, approves of an introduction of this sort, there is the immediate implication that he is acting on the advice of his consultants. With an approval, the machinery for introduction is set in motion. Without significant objection, at either the State or National level, it is simply a matter of time, and short time at that, until the introduction becomes a *fait accompli.*

For those who would take precious time in Man's battle against pestiferous snails, the thoughts might occur, "Is an introduction of this type really wise? Is it scientifically sound? Is it actually justified? What if the experiment does not work —then what? Are any dangers involved?" In an attempt to find answers to these questions, there should be an examination of the very small store of knowledge available on this subject.

First of all *Gonaxis* has not been scientifically proven to be capable of controlling *Achatina fulica* or, for that matter, even any snail in its own native heath. The observed buildup of *Gonaxis* on Agiguan is not *ipso facto* evidence that there is present an inherent capacity for controlling snails by predation. A survey of the ecology of Agiguan was not made prior to the release of *Gonaxis* and the observed results today therefore cannot properly be evaluated. This is especially the case since the bases of evaluation used in the several expeditions to Agiguan are of different caliber and are therefore not resolvable to comparison. Only a beginning has been made on a determination of the gustatory affinities and idiosyncrasies of *Gonaxis;* but even with an exhaustive examination and testing in the laboratory, there is no way of predicting for certainty what will take place in the field at the population level. Nor can one safely speculate transphyletically from the classical examples of biological control in the insect world.

As to the potential dangers, there are several. If the establishment of other foreign snails is any criterion, *Gonaxis,* once established, will not be eradicated. Such is a road on which there is no turning back. Furthermore, secondary foci will unavoidably develop in spite of internal quarantines or other

measures to check their spread. What the snails will do in Louisiana and Florida is anybody's guess. In the Pacific Islands, the greatest potential danger is the irretrievable loss, even before they can be studied, of the endemic snails, which because of their secretive habits form precious "keys" indeed for unlocking the vast zoogeographic storehouse of the Pacific. And now that snails are known to carry disease of their own, still another item of precaution has made its appearance. It may be apropos to recall at this point that *Gonaxis* was reported last year to be dying off inexplicably in appreciable numbers in the area of its first release on Agiguan.

In view of these fragmentary data, what sort of prognostication can be made at this early date? Actually, until it is known, among other things, just how much chilling *Gonaxis* can withstand, any prognostication can be hardly more than speculation. In the warmer regions of this country, such as the areas where *H. aspersa* is damaging citrus, *Gonaxis* probably will be able to survive. In spite of the fact that *Gonaxis* has demonstrated its ability to tolerate fairly long periods of drought in coastal East Africa, there is less certainty about its ability to survive in the open, grassy, usually very dry banks of the Tiajuana River where *H. aperta* has become so thoroughly established in the past few years. *Gonaxis* has the habit of burrowing three to four inches below the surface of the ground during unfavorable conditions; this may possibly permit it to escape the effects of frost or near-frost temperatures. But it might not. Therefore there is no way of predicting how far north in the United States secondary infestations might become successfully established. Snail-infested greenhouses quite probably will form the outposts of penetration.

In areas where environmental conditions are suitable, *Gonaxis* will build up in numbers, but subsequently it will go into a decline. The resultant residual population will reflect the effects of the selecting force of the environmental factors. Since the complement of environmental factors will be different from that of the autochthonous area, there might well be commensurate differences in the populations—depending, of course, upon both the genetic makeup of the introduced specimens and the relative genetic stability of the species. But the introduced specimens will have come from a population which has already suffered

the modifying effects of a strange environment in Agiguan! Whether any acceptable foreign environment or combination of foreign environments can influence, through a number of generations, the formation of a population of individuals with strikingly different feeding habits, is problematical, but certainly it is not impossible. Nor would change of feeding habits constitute a reversal of evolution, for herbivorousness and carnivorousness are merely the extremes of a flexible scale of omnivorousness on which there is every possible intergradation. It is the nature and affinities of the individuals of the residual population which will determine the relative success of the proposed experiment—and no one can contemplate these.

Finally, there is a very great chance that if *Gonaxis* can become established, it will eventually settle down in a semblance of endemicity, doing little good or little harm save possibly the extinction here and there of a localized endemic snail for which it has developed an especial appetite. Conversely, there is a slim chance that it will make considerable and permanent inroads in the populations of the introduced helicines; and it is on this that the authorities concerned are pinning their hopes. With the odds and penalties so great, it is questionable, in the present seriously inadequate state of our knowledge that the decision to introduce *Gonaxis kibweziensis* into continental United States and in the islands of the Pacific is a wise one at this time. But in an adjudged emergency, with its unfortunate concomitant ''pressures,'' any measure that holds even the faintest promise of success, irrespective of so-called ''minor side effects,'' is considered by many to be worth trying. As one has said, ''When crops are at stake, one cannot afford to be a conservationist.'' But there is also an old adage, ''The remedy is worse than the disease.''

NEW AND LITTLE-KNOWN MEXICAN HELICIDAE (MOLLUSCA, PULMONATA)

By ALAN SOLEM

Museum of Zoology, University of Michigan

During the author's tenure as Jessup Fellow at the Academy of Natural Sciences of Philadelphia from June through August

1955, preliminary studies were made towards a revision of the Mexican Helicidae. Since completion of the study will be delayed, the figuring of two previously unfigured species, description of a new *Humboldtiana* and addition of several locality records to the range of *H. durangoensis* Solem seem worthwhile.

I am indebted to Dr. Harald A. Rehder of the United States National Museum (USNM) for the loan of type material, to the Jessup Fund Committee of the Academy of Natural Sciences (ANSP) for their financial support and to Dr. Henry A. Pilsbry for his invaluable advice.

HUMBOLDTIANA QUERETAROANA Dall Pl. 3, figs. 4, 5, 6

(see Nautilus **11** (7) : 73)

The unique holotype (USNM 134691) from 8000–9500′ at Pinal de Amoles, Queretaro, Mexico, is a high-spired, bandless shell of the same degree of granulosity as *humboldtiana* Pfeiffer, *nuevoleonis* Pilsbry, *buffoniana* Pfeiffer and *taylori* Drake (see PILSBRY 1927: pl. 13, figs. 2–3). It differs from all of these in its higher spire, lack of color bands and prominent white axial streaks. The sculpture, umbilicus and apertural callus are nearest to *buffoniana* Pfeiffer and further collecting may show that *queretaroana* is only a high-spired, bandless subspecies of *buffoniana*. The less depressed apex mentioned by Dall may have been the result of an injury, since the shell has a slight break just below the embryonic whorls. The high spire is more characteristic of the *durangoensis* complex, but the lack of color bands, much heavier sculpture, smaller nuclear whorls and less deeply impressed sutures ally *queretaroana* to the *humboldtiana* series.

HUMBOLDTIANA DURANGOENSIS Solem

(see Nautilus **68** (1) : 4–6, pl. 1, figs. 2, 6)

Apparently *H. durangoensis* is the common species of the Sierra Madre Occidental from the drainage basin of the Rio Mezquital near Durango city, north to the Rio Mayo in SW. Chihuahua. Specimens from Tepehuanes (105° 42′, 25° 22′) (USNM 198517), El Bonete (105° 55′, 24° 55′) SW. of Santiago Papasquiaro at 8000′ (ANSP 164047) and at 9000′ on the trail from

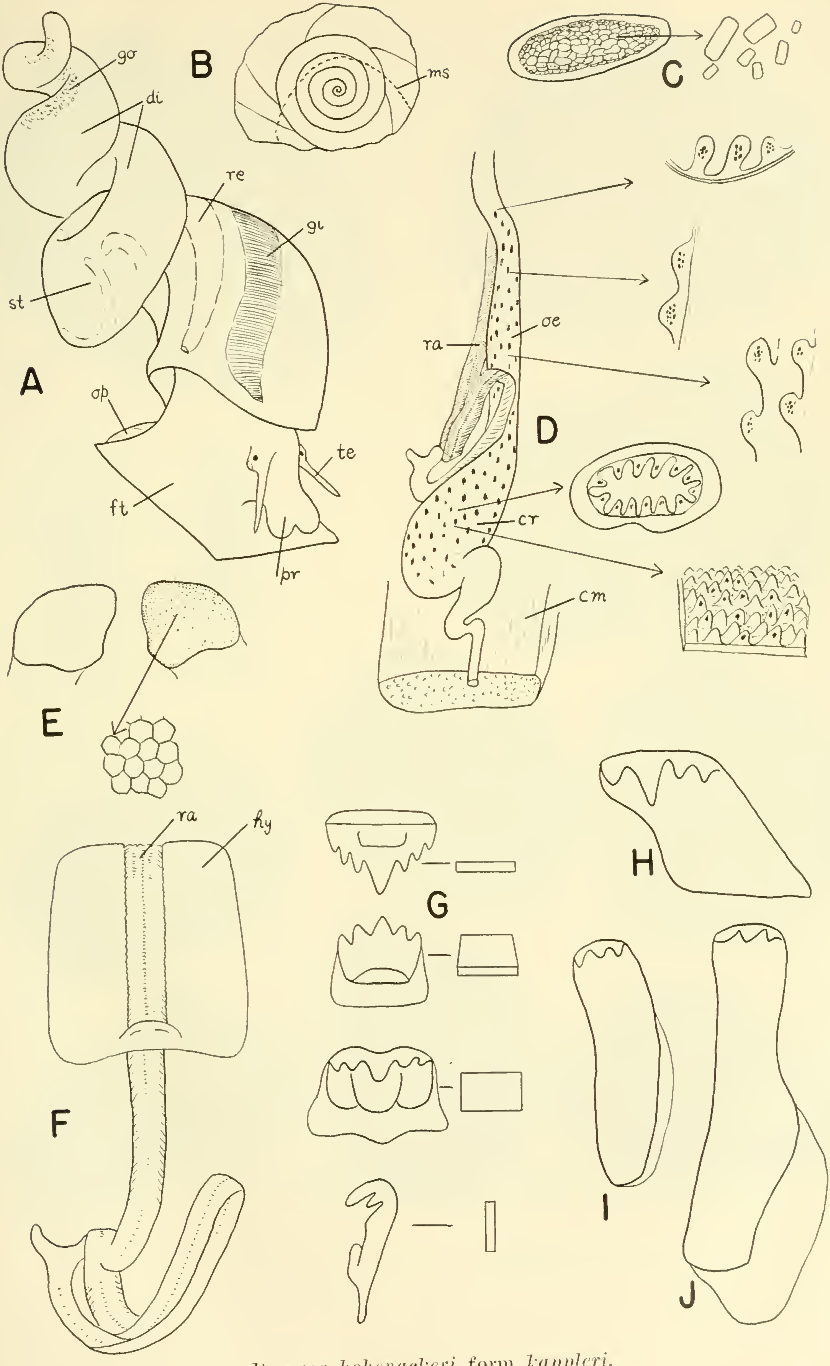
the town of Pueblo Nuevo (105° 24′, 23° 24′) to the Metates lumber camp, Durango (ANSP 164053), give additional locality records near the northern edge of the Rio Mezquital drainage. The actual basin of the Rio Mezquital is inhabited by an undescribed *Humboldtiana* which probably extends into Zacatecas and Aguacalientes (ANSP and USNM undescribed specimens). Near Concepcion del Oro in eastern Zacatecas, another species, *H. chrysogona* Pilsbry is found (ANSP 164055 and ANSP 164067). In SW Chihuahua, shells from Lareto (ANSP 188914) and the Sierra Saguaribo (ANSP 195108) on the Rio Mayo are juvenile, but not conchologically separable from the southern Durangan shells. Adult specimens from 65 mi. E. of Batopilas (approx. 106° 40′, 26° 35′) near the Rio Verde (USNM 251794) also seem to be *durangoensis.* The exact boundary between *durangoensis* and the *högeana* group remains uncertain, but will probably be found in southern or central Chihuahua.

The numerous fine granulations, dull color, large nuclear whorls and many white color streaks easily separate *durangoensis* from the *humboldtiana* series. The specimens from El Bonete are quite large, the largest individual being 45.9 mm. in diameter, 41.1 mm. high with 4⅜ whorls.

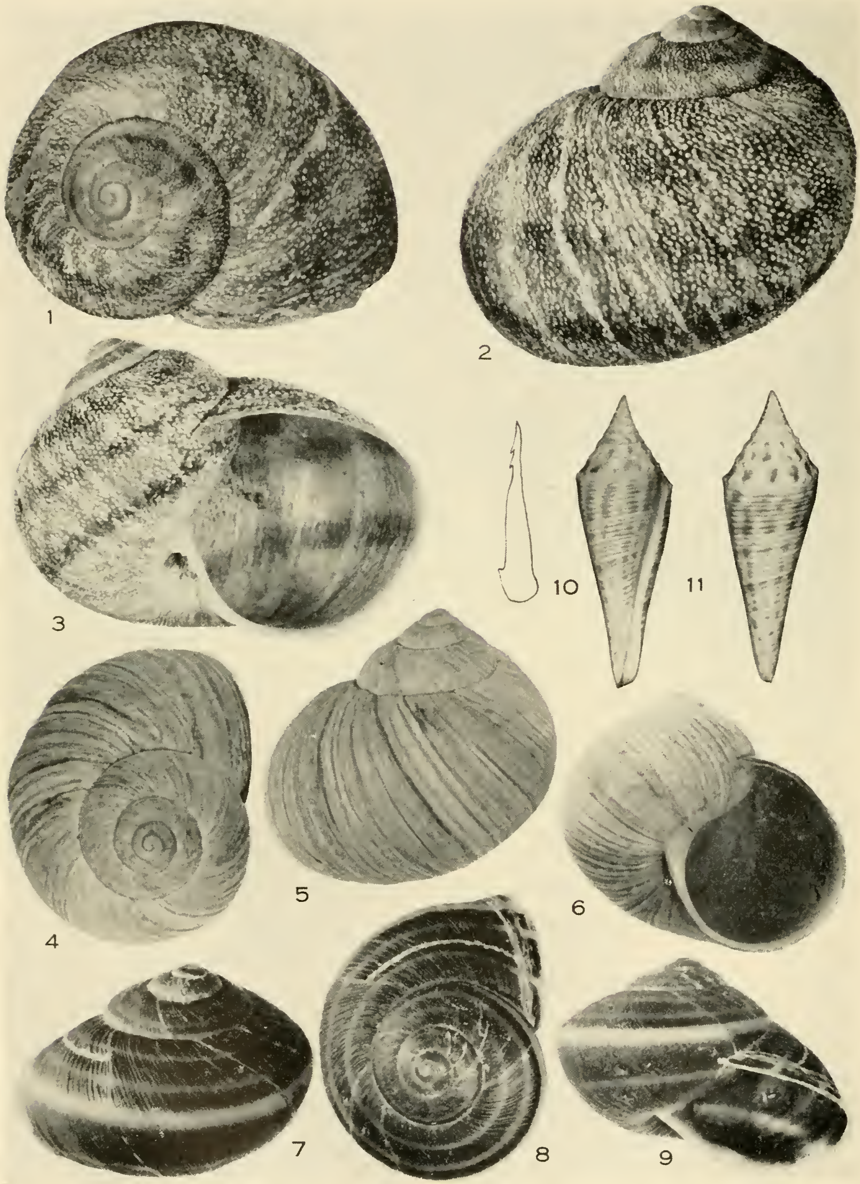
Humboldtiana pergranulosa, new species Pl. 3, figs. 1, 2, 3

Diagnosis: A *Humboldtiana* the size, shape and coloration of the *humboldtiana* Pfeiffer series, but allied to *durangoensis* by its impressed sutures, large nuclear whorls and umbilicus. It differs from both groups, and all other *Humboldtiana,* in the very large granulations, hence the name *pergranulosa.*

Description: Shell large, solid, helicoid. Whorls 4¼, rapidly increasing in size with moderately impressed sutures. Nuclear whorls 1½, large, smooth, with a brown band below. Next whorl worn, with only a few minute granulations. Penultimate and body whorl with very large (0.05–0.75 mm.), numerous white granulations. Ground color light chestnut, with three reddish-brown spiral bands, the upper slightly wider than the lower two. Aperture ovate, parietal callus almost absent. Lip broken, but basal and columellar portions are slightly reflected.



Doryssa hohenackeri form *kappleri.*



1, 2, 3, *Humboldtiana pergranulosa.* 4, 5, 6, *H. queretaroensis.* 7, 8, 9, *Lysinoe sebastiana.* 10, 11, *Conus mcgintyi.*

Diameter 42.5 mm., height 40.7 mm.

TYPE LOCALITY: San José Range Mts., Durango, Mexico.

HOLOTYPE: ANSP 194820, ex Brooklyn Museum.

REMARKS: The size of the granules at once separates *pergranulosa* from all the other *Humboldtiana.* The general appearance of *pergranulosa* is perhaps nearest to *durangoensis,* but the tremendous difference in size of sculpture alone makes separation advisable.

The exact location of the San José Mountains was not specified. There are nine towns named San José in Durango, but the most probable location is in NE. Durango near the town of Jaralito. The U. S. Army Mexican Air Navigation Map N-G 13-North shows a Cerro San José (104° 15′, 26° 12′) located near a spur of the Mexican National Railways just north of Jaralito. The isolated nature of the mountain and proximity to the railroad make it rather probable that such a striking endemic could have developed and yet been accessible to collectors in 1903.

LYSINOE SEBASTIANA Dall Pl. 3, figs. 7, 8, 9

(see Nautilus **11**: 74–75)

The unique holotype (USNM 251792) was collected by Nelson in a canyon near Milpillas, about five miles from San Sebastian, Jalisco, Mexico on March 16, 1897. The elevation was between 3850′ and 6000′. A second specimen (UMMZ) was collected by I. J. Cantrall at 6650′ on the Sierra Autlan about 20 miles SSE of Autlan, Jalisco. The Autlan shell is in much better condition and has been figured for that reason. To Dall's description it might be added that the last whorl descends sharply and the lip is slightly reflected and thickened.

The Autlan shell is much smaller than the holotype and has umbilical and a sub-peripheral color bands which the type lacks. The comparative measurements of the two shells are:

Holotype: diameters 41.6 and 33.2 mm.; height 0.03 mm.; 4¼ whorls.

UMMZ: diameters 32.1 and 28.1 mm.; height 24.1 mm.; 4½ whorls.

L. sebastiana is obviously related to *L. eximia* (Pfeiffer) from Guatemala, but differs in having a keeled periphery, less strongly reflected lip, darker color and finer sculpture. A fully relaxed animal of *sebastiana* was obtained and a study on the anatomy will be published later.

ANATOMY OF THE VENEZUELAN GASTROPOD, DORYSSA KAPPLERI

By R. TUCKER ABBOTT

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This is a brief account of the gross anatomy of one of the two fresh-water species of mollusks obtained on the Franco-Venezuelan Expedition to the upper reaches of the Orinico River in 1951–52. This was a government sponsored expedition led by Major Franz Risquez, F. A. V. Dr. Luis Carbonell collected a total of 100 fresh-water specimens in four localities along the river. Samples of the shells are in the Museo de Ciencias Naturales in Caracas, the U. S. National Museum in Washington, D. C., and the Museum of Comparative Zoölogy at Harvard College, Massachusetts.

The accompanying anatomical drawings depict the gross anatomy of *Doryssa hohenackeri* Philippi, form *kappleri* Vernhout 1913. The other species, which we did not dissect, is *Doryssa decollata* Lamarck 1822. The latter differs from *hohenackeri* in having very distinct decussate sculpturing which may be seen in the illustration of Lamarck's type (Mermod, G., 1952, p. 72, fig. 134–3). We do not think that Haltenorth and Jaeckel (1940, p. 112) were justified in considering these species as the same.

Doryssa hohenackeri, form *kappleri* Vernhout

D. kappleri was found in large numbers clinging to the rocks in the rapids of the upper reaches of the Orinoco River. The pH of the water was 5.7, a slightly acid condition likely re-

sponsible for the eroded spires of all specimens. An aquatic plant (*Podostemonaceae*) was found associated with the snails. Dr. Carbonell reports that these mollusks are eaten by the Waica (Oiaca, Uaica, Guaica, Uaika or Waika) Indians of that area.

The collecting localities are all on small tributaries of the Rio Orinoco in Territoria Amazonas: La Esmeralda (May 20, 1951); Randal Guaharibo (July 20); Ugueto; and Salto Bobadilla (Sept. 29).

Shell.—Turreted conic, with the early whorls eroded away; length of adults varying from 25 to 40 mm., width 10 to 15 mm. Early whorls with almost flat sides, becoming increasingly rounded in the last three or four whorls. In young specimens, periphery of whorl rather sharply angulate, but in adults the last whorls are gently rounded. Aperture broadly oval and almost as wide as high. In adults, the outer lip is usually thickened on the outside, particularly at the shoulder. Columella very short, flattened laterally, and advanced at the base. Shell smoothish, except for microscopic lines of growth. Spiral sculpturing very weak, consisting of three to seven fine grooves which are more prominent just below the suture. Lowest part of the base of the shell with three to four weak, rounded spiral threads. Suture smooth, finely indented, and with the upper whorl slightly overhanging. Color of shell light-yellowish brown to dark olive-yellow with numerous, irregularly-placed and—shaped spots of dark chestnut-brown which in places coalesce to form short, axial flammules.

Animal (Pl. 4, figs. a-j).—The animal is typical of that found in the pleurocerid prosobranchs, having a broad, anteriorly bifurcate proboscis and relatively short tentacles with rather swollen eye bases. The color of preserved animals is dark blackish gray to black. Operculum chitinous, transluscent-brown and multispiral. The only unusual feature noted in the anatomy are the numerous, blunt papillae that line the wall of the esophagus and crop. Each of the papillae, which are possibly secretory in function, is embedded with fine clumps of melanistic granules. The two otocysts located at the base of the cerebral ganglia are elongate in shape and each contains about 100

variously-sized, oblong otolith crystals. The gills consist of about 200 low lamellae that are welded to the mantle. The inner wall of the buccal opening is strongly plicate longitudinally. Behind are two light-tan, translucent jaws. The radular ribbon is long, consisting of about 105 transverse rows of teeth. The first 20 rows are exposed and used for rasping.

Doryssa decollata Lamarck

Thirteen immature specimens, of which the largest is 20 mm. in length, were collected at Ugueto, and seem referable to Lamarck's species, *D. decollata*. They are characterized by a very distinct microscopic sculpturing which is very evident in the rather thick periostracum. The periostracum has strong spiral and axial threads which cross at right angles to give a woven-cloth or beaded appearance. The shells differ from *kappleri* in having a flatter-sided spire of about 28° to 30°, while the former has a spire angle of about 22° to 25°. The color markings are more suffused and darker. The spiral threads at the base of the shell are much stronger. The operculum is the same.

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Pl. 3, figs. a-j. *Doryssa hohenackeri,* form *kappleri.* A, entire animal with its shell removed; B. operculum; C. otocyst and its otoliths; D. view of esophagus showing the papillae in cross-sections; E, jaws showing detail of structure; F. entire radular ribbon; G, four views of the central tooth; H. lateral tooth; I inner marginal; J. outer marginal. (cm = columellar muscle; cr = crop; di = digestive gland; ft = foot; gi = gills; go = gonads; hy = hyaline sheath; ms = muscle scar; op = operculum; pr = proboscis; ra = radula; re = rectum; st = stomach; te = tentacle.)

ANOTHER FLORIDAN CONUS

By H. A. PILSBRY

CONUS MCGINTYI new species Plate 3, figures 10, 11

Shell rarely reaching 2 inches in length, long, narrow, rather thin, of about 12 whorls, including a glassy-smooth nucleus of nearly 3 whorls. Spire extended, slightly concave, with the carina (immediately above suture) prettily beaded on the early whorls, the tubercles gradually becoming subobsolete on the last whorl. There are 4 to 6 lightly wrinkled threads on the sloping whorls of the spire. Body-whorl long, nearly flat-sided, with spiral sculpture of flattened smooth cords separated by slightly narrower grooves which are crossed by delicate axial threads giving the surface a punctate appearance. Aperture oblique, long and narrow. Color cream with dots or blotches of light shades of brown, which are often arranged in spiral rows, or streaked and diffused longitudinally. Periostracum very thin, straw colored. No operculum.

Holotype: Length 41.6 mm., greatest width 11.7 mm., length aperture 30.5 mm., ANSP No. 193858, dredged 165° off Pensacola, northwest Florida, by T. L. Moise, yacht "Escape," July 12, 1954.

Figured paratype: Length 42.1 mm., greatest width 13.5 mm., in the McGinty collection, dredged living off Palm Beach, Florida, in 70 fathoms, bottom mud and broken shell, "Triton" Sta. 1256, August 24, 1953. Paratypes in the McGinty collection from off Palm Beach, Sombrero Key Light and Key West. Paratypes in the collections of Dr. Jeanne S. Schwengel and Mr. Arthur R. Thompson from the "Triton" dredgings. Depth range known for live specimens in 70 to 120 fathoms.

This unusual cone has been figured in recent shell literature as *Conus mazei* Deshayes. ("Johnsonia" No. 6 by William J. Clench, Plate 9, figures 1 and 2; "American Seashells" by R. Tucker Abbott, in color, Plate 14 K.) Mr. Axel A. Olsson when abroad last summer examined the holotype of Deshayes in the Paris Museum and he agreed with the conclusion I had formed from a study of the description, that there are two distinct species which in Florida have passed under the old name of *C. mazei*. For the specimens which are uniformly sulcate all

over the body whorl, the new name *Conus mcgintyi* is proposed. The true *C. mazei,* from Martinique in 50 fathoms, is apparently known only from the unique type of Deshayes. It differs conspicuously from this new species by the smooth, shining surface of the body-whorl and the regular brown spots arranged as in *Scaphella junonia.*

There are several slender, strongly sculptured fossil cones, of which *C. gracilissimus* Guppy from the Miocene of Jamaica appears to be the nearest to *mcgintyi.*

The type of this cone was collected dead, but Mr. Thomas L. McGinty has supplied the following details from living specimens dredged by the "Triton." The animal is a dull yellow with the sides of the foot and the area around the head peppered with small black dots. A marginal tooth from the toxoglossate radula is shown in figure 10. The tooth has two barbs on one side and is very small, .19 mm. length. The camera lucida drawing was made 310×. While making a microscopic examination for an operculum, a pair of very minute mandibles was found, probably, from a very small Cephalopod eaten by the cone.

This striking new cone is named for Thomas L. McGinty.

SOME MALACOLOGISTS OF THE NEW YORK AREA

By MATHILDE P. WEINGARTNER

Staten Island Institute of Arts and Sciences

During the latter part of the 19th century and the early part of the 20th there appear in the annals of malacological history a few names of men who lived or worked in the New York area, and who, not only because of the hobby they pursued, but because of the people that this hobby brought together, led very interesting lives.

These men may have had demanding jobs in the economic struggles during their lifetime, but either as a diversion or as a long delayed hobby in their older years, they took up natural history. Most of them were well acquainted with each other and spent a great deal of time in the field. They collected ex-

tensively, exchanged notes on their collections, and enriched more than one museum with their finds. Here, after considerable research, are a few glimpses into their very interesting lives.

Temple Prime was born at 1 Battery Place, N.Y.C. on September 14th, 1832, the son of Rufus Prime. He was educated abroad, and upon his return took a course at Harvard Law School. He was for some years connected with the United States Legation at The Hague. When this service was over he returned home and, as he had an ample fortune, he never entered upon the practice of his chosen profession, but spent his time managing his large estate at Huntington, Long Island. He wrote a genealogy of the Temple family, which apparently stemmed from English nobility.

In conjunction with Sanderson Smith he wrote *A Report on the Mollusca of Long Island* published in theAnnals of the Lyceum of Natural History, Vol. 9 (1870). He described the little *Gemma manhattensis,* but his chief work was on the fresh water fingernail or pea clams, publishing many papers on the Corbiculidae (+ Sphaeriidae) in the Proceedings of the Academy of Natural Sciences of Philadelphia, the Annals of the Lyceum N. H. of N. Y. and elsewhere. His *magnum opus* was the "Monograph of American Corbiculidae," in the Smithsonian Miscellaneous Collections, no. 145 (1865). Though now long past its useful times, this 90 year old monograph remains our only American manual of this ubiquitous and very difficult family. Prime's collection was left to the M. C. Z.

Silas Carmi Wheat was born in Franklin, N. Y. on December 11, 1852. He was graduated from the Delaware Library Institute in 1876. After many years of teaching he received from New York University in 1898 the degree of Master of Pedagogy. From 1894 until his death he was a resident of Brooklyn, N. Y. In 1910 he became president of the New York Men's Teachers Association. The impetus of his strength is still felt in New York educational circles today.

But for his work as a scientist he will perhaps be most widely recognized and longest remembered. He wrote many articles on nature topics. He was long a member of the Conchological Society of Great Britain and Ireland. For the State Museum in Trenton he prepared a *Report on the Mollusks*

of New Jersey and for the Brooklyn Institute of Arts and Sciences he wrote a similar *Report on the Mollusks of Long Island.* He contributed several papers to the Bulletin of the Brooklyn Conchological Club (1907), of which he was President, one of them a "List of Long Island Shells." He also wrote a genealogy of the Wheat family. He was an honored member of the Brooklyn Entomological Club as well as the Brooklyn Conchological Club. He died suddenly on September 1st, 1922.

A contemporary of the previous two gentlemen was LOUIS POPE GRATACAP. He was born in Brooklyn on November 1st, 1851, the son of John and Lucinda Gratacap. He was graduated from the College of the City of New York in 1869, and from the Columbia School of Mines in 1876. The family had moved to Staten Island many years before, and it was from here that young Louis attended college, a tedious journey in the days of slow ferries and horse cars.

He was connected with the American Museum of Natural History from 1876 on and became Curator of Mineralogy in 1881. With one assistant, Mr. Quinn, he not only kept the great collection of this museum, both mineral and shells, in excellent order, but he found time to give the displays artistic settings. His writings were of a varied character. Among them were: *Vade Mecum Guide to Mineral Collections,* Broadway Press, N. Y. (no date); three editions of the *Geology of The City of New York,* Henry Holt & Co., and Brentano, N. Y., 1901, 1904, and 1909. His principal conchological papers were a catalogue of the Binney & Bland Collection in the American Museum, and several articles published in NAUTILUS, 1906 to 1914. His non-scientific writings include: *Substance of Literature,* Frank Rogers, N. Y., 1913; *Philosophy of Ritual,* James Pott & Co., N. Y., 1887; *Analytics of a Belief in a Future Life,* James Pott & Co., N. Y., 1888; and novels like *A Woman of the Ice Age,* Brentano, N. Y., 1906; *Benjamine The Jew,* Thomas Benton, 1913; and *The Evacuation of England,* Brentano, 1908.

As a lecturer Mr. Gratacap had few equals. Not only did he have original ideas, but these were expressed through the medium of a remarkable vocabulary. He never cared to go into public life but lived quietly with his brother. He had a great many friends and was always helpful to them both with kindly acts and financial aid.

In 1881 he became a member of the Natural Science Association of Staten Island, and from 1887 to 1888 he was president of this organization. From 1884 to 1901 he contributed twenty-four papers to the *Proceedings* of this institution among them a *Memorandum on Lymnea palustris,* Vol. 11, May 1891. In this paper he described an experiment he carried on with these snails, maintaining them in very cold water over winter. He found that they survived, and he watched them breeding the following spring. Other authors had believed that they wintered in the form of eggs, a fact now disputed by Mr. Gratacap. His busy life ended in December 1917, and he is buried in the family vault in the churchyard at Trinity Church, Manhattan.

Another Staten Islander who gained fame in the malacological world is Sanderson Smith. He was born in London, England, in 1832 and died in Port Richmond, Staten Island, in 1915. Little seems to be recorded about his early life and education, but he was well known for the work he did for the United States Fish Commission.

From 1881 to 1893 Mr. Smith was engaged by the American Museum of Natural History to catalogue, label, and arrange the shell collections, under Professor R. P. Whitfield.

He was elected first president of the Natural Science Association of Staten Island in 1881 and made a number of contributions to the *Proceedings* of this organization. Among these were: *Notes on the Mollusca of Staten Island, Note on the Distribution of Littorina Littorea, Note on Limax Maximus* and *Notes on the Shells of the John J. Crooke Collection.*

Of great interest to the local malacologists are: A *Catalogue of Mollusca of Staten Island,* A *Catalogue of Mollusca of Little Gull Island, Suffolk County,* N. Y., and his earliest paper, *On the Mollusca of Peconic and Gardiner Bays, Long Island* which was read before the New York Lyceum of Natural History on December 5th, 1859, and printed in their *Annals* in 1862. The other two papers were printed in the *Annals of the Lyceum of Natural History* in 1867.

Mr. Eber Ward Hubbard, according to Leng and Davis' *Staten Island and its People,* was born October 8th, 1797 in Jefferson County, N. Y. He practiced medicine in La Grange and Elmyra, Ohio, before he settled in Tottenville, Staten Island. As an avocation he studied shells and, with Sanderson

Smith, published that first *Catalogue of Staten Island Mollusca* in 1865, which later appeared in the Annals of the Lyceum. In this report his name is erroneously given as J. W. Hubbard. He died May 7th 1872.

John J. Crooke, another of Staten Island's naturalists and collectors was born in Columbia County, N. Y., in 1824. He came to Staten Island and purchased a large tract of land on the south shore of the island, where he built his house. This point of land for many years bore his name, Crooke's Point, until the New York City Department of Parks took over the area and called it "Great Kills Marine Park." Mr. Crooke purchased and collected numerous natural history objects, including herbarium specimens and shells. These later found resting places in libraries and museums.

Sanderson Smith was given the job of going over the shell collection which Mr. Crooke had accumulated, but he did not find anything new to add to the list of local shells. Mr. Crooke's collection consisted mainly of land shells, and, as such, was a rather complete one. He not only had a great deal of local material, but a large collection of shells from the West Indies and South America assembled by Thomas Bland, and a collection of land shells from the Pacific Islands by William Harper Pease. Mr. Crooke does not seem to have interested himself in marine shells, as his collection of such was a very small one. Mr. Crooke's shells were presented to the American Museum of Natural History.

Thomas Bland, 1809–1885, one of the great figures in American land shell lore, was born in England, but he resided for more than thirty years of his life in New York City. He had lived for a time in Barbados, Jamaica and in Colombia, and became deeply interested in West Indian land shell faunas. Upon coming to New York he took up the study of United States land shells, and collaborated with W. G. Binney in several important publications. Bland was author of more than 70 papers, dealing with West Indian and North American land shells, their distribution and relationships.

Perhaps Staten Island's foremost naturalist and collector was William Thompson Davis. "One Davis," as he liked to refer to himself, was born in 1862 into an old Staten Island family, the Thompsons, and an equally fine New England family, the

Davises, of Freetown, Massachusetts. He grew up with his mother's people, and his only formal schooling came from two Staten Island private schools. From early childhood he was interested in flowers, plants, insects, mammals, and any other natural phenomenon.

From 1883 to 1909 he worked faithfully at a book-keeping job for the New York Produce Exchange. Being of a frugal nature, he accumulated a small sum of money which, wisely invested, brought back a comfortable living, so that he could devote himself to his hobbies from 1909 on. His main interest was entomology, but he by no means neglected other fields of nature. Having always gone afield and collected natural objects, he did not neglect shells. Among other specimens, among those carefully put away in shirt boxes, cigarette boxes, or vials was a *Mya arenaria,* from whose grip he had released a hapless sandpiper. All his specimens were carefully labeled, except that the location given may be rather vague, such as "South Shore, S.I." This was due to the fact, perhaps, that Mr. Davis was always conservation-minded and afraid that someone else might go to the location and collect to excess. Mr. Davis carried on a lively correspondence with many naturalists, and conchologists, such as Silas Wheat. In the Proceedings of the Staten Island Institute of Arts and Sciences he also wrote about the first occurrence of *Littorina littorea,* this being a milestone in the migration of this mollusk along the Atlantic coast.

"Willie Davis" or "Uncle Billie," as he was affectionally called, will long be remembered by his friends, of whom he made many in almost 80 years of nature rambling.

Many museums in the New York area can give thanks to the diligent work that these men have contributed in the field of malacology.

A NEW CLAM INDUSTRY IN NEW ENGLAND

By HENRY D. RUSSELL

A new deep ocean clam industry, dredging *Arctica islandica* Linné, was incorporated in Massachusetts in February 1954. This company, The Cape Cod Shellfish Corporation, was founded

as a result of pioneering surveys carried forward by the Woods Hole Oceanographic Institution during 1949. These surveys indicated that there were beds of *A. islandica* in commercial abundance south of Cape Cod and in Massachusetts Bay.

The purpose of this company was to dredge these clams, eviscerate, chop, freeze them and attempt to meet the ever increasing demand for frozen sea foods for the institutional and restaurant trades. The use of polyethelene bags prevents contamination and loss of flavor and insures a high degree of sanitation for the chopped meats which are frozen in five pound blocks, ten blocks to the case. A large plate-type freezer freezes one and one-half tons in two and a half hours and the removed frozen blocks are then ready for distribution or storage at −10° F. at which temperature they keep for six months to one year without deterioration.

The processing plant is located on the south bank of and at the eastern end of the Cape Cod Canal. Here the vessels can come alongside the dock and unload their deck cargos of culled and washed clams directly into a conveyor leading to the shucking room. Five minutes after the two-bushel, mud-free boxes of clams are unloaded from the dredging vessel they are on the tables in the shucking room and ready for removal of the shells. An experienced shucker can shuck clams at a rate of one every 3–5 seconds. A deft turn of the shucking knife sends the shells into an empty 50 gallon drum and the meats into a ten-quart stainless steel pail perforated with small holes. Through these holes the clam juice drips into a second pail where it is caught, later to be strained and frozen in one-gallon tins. It is used chiefly for clam bouillon, adding flavor to clam chowders and for clam juice cocktails.

As the stainless steel buckets are filled with clam meats, they are passed through a window to the processing room. Here the clams are eviscerated which removes the dark digestive gland, gonads, stomach and intestine. The next step in the process takes the eviscerated meats to the washer, a large circular stainless steel tank three feet in diameter by two and a half deep. Here they are stirred and agitated in water through which air is forced under pressure, thus turning them over and over and washing off any bits of broken shell or adhering mud. Cleaned after five minutes, they are released from

the bottom of the tank and poured onto a drain board. Next they are cut into approximately ⅜-inch pieces and then weighed out into five pound lots which are poured into polyethelene bags. When a truck load of these five-pound bagged lots in their respective waxed boxes has accumulated, it is sent to the freezer a few miles away and the freezing and storage process begins.

In addition to the shucking and processing rooms, there is a second floor laboratory in the plant where the biology of *A. islandica* is under investigation and where a dietician devises new recipes and uses for clam products.

This is but half the story, however, for it is the action on the dredging vessels that is the stimulus for the events that take place in the plant. Leaving the Cape Cod Canal early in the morning to take advantage of calm weather conditions, the dredging vessels arrive at the dredging grounds one to one and one-half hours later. The two iron, 16-toothed, dredges with their 7-foot iron ring bags are then lowered by a steel cable one over each side. Feeling the vibration of the cable an experienced fisherman can determine manually when the dredge is on bottom, in general, what type of bottom, and whether the dredge is fishing properly or not. After 20–30 minutes, the dredge is brought to the surface, the draw strings of the iron ring bag are pulled and the contents dumped on deck. The catch is sprayed with salt water to wash off any mud and the culling process begins. Broken shells and extraneous matter are thrown over the side while whole clams and broken ones are placed in separate 2-bushel wooden boxes and stacked on deck. As the first catch is culled and stacked in boxes the dredge is lowered over the side again and the second one starts towards the surface where the process is repeated. This series of events requires about twenty minutes so that it is about time to haul the second dredge as the first one is lowered for the second time. When a deck load has been gathered the vessel returns to the plant where processing begins. Thus within twenty-four hours of the time the clams leave their ocean bed they are cleaned, frozen and ready for distribution. Their distribution during the first year of operation has taken *A. islandica* from Cape Cod south to Norfolk, Virginia, westward to Oakland, California, into many hotels and restaurant chains

in the northeastern and middle Atlantic states and into many Massachusetts State Institutions.

After each day's work both the shucking and processing rooms and the apparatus in them are thoroughly washed with hot water, soap or disinfectants, as a high standard of sanitation must be maintained and the rooms are made ready for the next day.

The officers of the new company are Mr. William C. Waugh, President, Mr. Charles T. Russell, Jr., Treasurer and the author as Secretary.

MINNESOTA LAND SNAILS

By CHARLOTTE DAWLEY

The purpose of this paper is to summarize the present knowledge of the land snails of Minnesota, exclusive of slugs. It is based largely on the collections housed in the Zoology Department of the University of Minnesota which were started in the 1880s by members of the Geological and Natural History Survey.

Minnesota is almost in the center of the northern tier of states, directly south of Ontario and western Manitoba. Most of the state is gently rolling or level, with an average elevation of about 1200 feet above sea level. All except the extreme southeastern tip has been glaciated at least once, and the effects are still visible in the many lakes and swamps.

Vegetationally there are three regions—coniferous forest, deciduous forest, and prairie. The northeastern third of the state was originally coniferous forest, with white pine, red pine, jack pine, white spruce, balsam fir and white birch in the well-drained areas, and black spruce, tamarack, and white cedar in the swamps. Much of this region is not a good habitat for snails, the soil being poor and with very little lime, but many of the smaller species are found in the wetter places and in the islands of maple-basswood found here and there among the predominating conifers.

Bordering the coniferous forest on the west and south was a strip of deciduous forest, narrow in the northwest, broadest in the central part of the state and narrow again along the

Mississippi River to the Iowa line. Oaks predominate in the northern part. Sugar maple, basswood, elms, and red oak formed an extensive climax forest in the rich calcareous soils of the central part, now largely farms. Along the river bottoms the flood plain forests contain willow and cottonwood, with white elm and soft maple on slightly higher ground.

The southwestern part of the state was mostly prairie, with trees only along streams and around lakes. Very little collecting of land snails has been done in this part of the state.

Land snails are reported from about thirty of the state's eighty-seven counties. The most concentrated collecting has been done in four different areas:

1) The southeastern corner of the state, chiefly in Houston and Winona counties. Underlain by limestone and dissected by many streams, the wooded hills along the Mississippi River and its tributaries have yielded many species. Collecting began in the 1880s with J. W. Holzinger, a professor at the Winona Normal School, and U. S. Grant of the Geological and Natural History Survey and has continued to the present time. North of this area some collecting has been done in Wabasha, Goodhue, Rice, and Scott counties.

2) The central part of the state around St. Paul and Minneapolis, in Ramsey and Hennepin counties. The University of Minnesota is found here and almost everybody who has been interested in mollusks in the state has worked in this region. It is an area of terminal moraines, cut through by the Minnesota and Mississippi Rivers. Pine, Chisago and Washington counties are a few miles to the east along the St. Croix River, and Anoka and Wright counties lie just north.

3) North central Minnesota. Collecting here has centered around Itasca State Park in Clearwater County, famous for containing the source of the Mississippi River. Since 1936 students of Dr. Samuel Eddy at the University of Minnesota Biological Station have collected here each summer. The most recent and most extensive collecting was done by Mrs. Marjorie Harrison in 1949. She also collected farther north around Red Lake in Beltrami County. L. E. Daniels collected in Marshall, Pennington, Red Lake, and Becker counties in 1909.

4) Northeastern Minnesota. St. Louis, Lake, and Cook Coun-

ties form a triangle north and a little west of Lake Superior. It is resort country, with many lakes and beautiful woods. U. S. Grant collected around Tower on Lake Vermilion in St. Louis County in the 1880s and F. C. Baker in the same region in 1929 as well as in Itasca County a little farther west. Mrs. Harrison in 1949 collected in Finland State Forest in Lake County and on an Indian reservation in Cook County. I have collected around Hibbing in St. Louis County.

Fifty-five species of land snails, not counting slugs, have been reported in Minnesota.

Family Polygyridae

Stenotrema hirsutum (Say). Abundant in Winona County, found also in Houston County. This is the smaller upland form.

Stenotrema monodon (Rackett). Abundant at Hidden Falls, a moist, shady glen on the banks of the Mississippi near St. Paul. Also found in damp places in Winona, Hennepin, Scott, and Wright counties.

Stenotrema fraternum (Say). Abundant in Nerstrand Woods in Rice County and at Taylors Falls in Chisago County. Widely distributed in central and southern Minnesota.

Mesodon thyroidus (Say). Found only in Winona County where it is abundant in Whitewater State Park.

Mesodon clausus (Say). Several places in Houston County, and once each in Winona and Ramsey counties.

Triodopsis albolabris alleni ('Wetherby' Sampson). Widely distributed in southern and central Minnesota.

Triodopsis multilineata (Say). Southern and central Minnesota. They all seem to be the small form *algonquinensis* Nason, which Pilsbry regards as an ecologic form inhabiting woods rather than marshes.

Allogona profunda (Say). Southern and central Minnesota, not found in large numbers anywhere.

Family Zonitidae

Euconulus fulvus (Müller). Whole state except southeastern part.

Euconulus chersinus polygyratus (Pilsbry). Whole state. It is difficult to separate *E. fulvus* and *E. chersinus polygyratus* in our material because of the scarcity of mature forms, but both species are present.

Retinella indentata (Say). Houston, Winona, and Hennepin counties, not abundant anywhere.

Retinella electrina (Gould). Whole state. Common.

Retinella binneyana (Morse). Reported by F. C. Baker in Itasca County and by Daniels from Becker and Red Lake counties.

Hawaii minuscula (Binney). Whole state except northeastern part.

Zonitoides arboreus (Say). Whole state. Very common.

Zonitoides nitidus (Müller). Central and southern part of state in wet places. Not common.

Striatura exigua (Stimpson). A northern species, found in damp woods or bogs. Our largest collection is from a bog in Itasca Park in Clearwater County, others from Finland State Forest in Lake County, and the Indian reservation in Cook County. A single specimen was found in Nerstrand Woods in Rice County.

Striatura milium (Morse). Whole state, more common in northern part.

Vitrina limpida (Gould). Rare; northern part of state.

Family Endodontidae

Anguispira alternata (Say). Whole state, more abundant in the southern part.

Discus cronkhitei (Newcomb). Whole state. Abundant.

Helicodiscus parallelus (Say). Whole state. Common.

Punctum minutissimum (Lea). All parts of state except the northeastern part.

Family Succineidae

Oxyloma retusa (Lea). Whole state.

Succinea ovalis Say. Whole state.

Succinea avara (Say). Whole state.

Family Strobilopsidae

Strobilops labyrinthica (Say). Common in all parts of the state. The colorless variety *virgo* is also found.

Strobilops affinis Pilsbry. Central and southern parts. Not common.

Family Pupillidae

Gastrocopta armifera (Say). Central and southern parts of state.

Gastrocopta contracta (Say). Whole state except northeastern part.

Gastrocopta holzingeri (Sterki). Abundant at Hidden Falls, Ramsey County. Whole state except northeastern part.

Gastrocopta pentodon (Say). Whole state.

Gastrocopta tappaniana (C. B. Adams). Central and northern parts.

Gastrocopta corticaria (Say). Found in small numbers in central and northern parts.

Pupoides albilabris (C. B. Adams). Rare. Houston, Winona and Ramsey counties.

Vertigo milium (Gould). Ramsey, Hennepin and Pine counties.

Vertigo ovata (Say). Hennepin, Ramsey and Clearwater counties, found especially on cattails or grasses on edge of lakes or swamps.

Vertigo elatior Sterki. Hennepin and Clearwater counties. Not common.

Vertigo ventricosa (Morse). Widely distributed through the northern part of the state, south to Hennepin County.

Vertigo tridentata Wolf. Rare. Houston, Ramsey, Chisago counties.

Vertigo nylanderi Sterki. Rare. Found by Mrs. Harrison in 1948 and 1949 at Bear Paw Point in Itasca Park, Clearwater County.

Vertigo gouldi (Binney). Widely distributed through the state. Large collections from Itasca Park, Clearwater County and Tower, St. Louis County.

Columella edentula (Draparnaud). Abundant in Beaver

State Park, Houston County. Also found in Winona, Hennepin, Pine, and Clearwater counties.

Family VALLONIDAE

Vallonia pulchella (Müller). Abundant in leaf mold at Isaac Walton Bass Ponds and Roberts Bird Sanctuary, Hennepin County. Also collected from Winona, St. Louis and Big Stone counties.

Vallonia costata (Müller). Hennepin and Ramsey counties.

Vallonia parvula Sterki. Rare. River flats, Hennepin County and Tower, St. Louis County.

Vallonia gracilocosta Reinhard. Whole state. Abundant in Itasca Park, Clearwater County.

Vallonia perspectiva Sterki. Abundant at Hidden Falls. Ramsey County. Also at other locations in central part of state.

Planogyra astericus (Morse). Rare. F. C. Baker found them in Itasca County and Mrs. Harrison in the Finland State Forest in Lake County.

Zoogenetes harpa (Say.) Rare. Our only specimens were collected in the 1880s by U. S. Grant from Tower, St. Louis County.

Family CIONELLIDAE

Cionella lubrica (Müller). Whole state, more common in north.

Family CARYCHIIDAE

Carychium exiguum (Say.) Found in small numbers in several places in Clearwater and Hennepin counties.

Carychium exile canadense Clapp. Common in leaf siftings from all parts of the state.

Family HELICINIDAE

Hendersonia occulta (Say.) Found in several places on the wooded hills and wet, rocky ravines along the Mississippi River and its tributaries in Houston and Winona counties.

Family Amnicolidae

Pomatiopsis lapidaria (Say.) Found in wet places in Houston, Winona, and Hennepin counties.

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SOME ECOLOGICAL FACTORS OF THE SOIL AFFECTING THE DISTRIBUTION AND ABUNDANCE OF LAND SNAILS IN EASTERN VIRGINIA [1]

By JOHN B. BURCH [2]

University of Richmond

The purpose of this investigation was to study land snail distribution in relation to certain inorganic compounds, hydrogen-ion concentration, and organic matter present in the soil.

Description of the area.—This study was made during 1952–54 in Hanover, Henrico, and Chesterfield counties, an area of

[1] From a M. S. thesis submitted to the Department of Biology, University of Richmond, June, 1954. This investigation was supported (in part) by a research grant from the Virginia Academy of Science.

[2] Present address: Museum of Zoology, University of Michigan.

1179 square miles in east-central Virginia. The area comprises two physiographic regions, the Coastal Plain to the east and the Piedmont Plateau to the west, which merge along a line that crosses each county, dividing Hanover and Henrico counties roughly into equal halves and Chesterfield County into an area about four-fifths of which lies in the Piedmont Plateau. The fall zone is several miles wide, with no definite boundaries.

The soils of the Piedmont province have been derived mainly from granite and gneiss formations and comprise primarily the Durham and Cecil series (Bloomer, 1938). The Cecil series is the most widespread type of soil occurring over the Piedmont region. It is a gray, red, or brown loam with a red clay subsoil. In its eastern part the Piedmont Plateau has an average elevation of about two hundred feet above sea level, but it rises gradually toward the west. What was formerly a plateau is now so deeply eroded by drainageways that little of the plateau surface remains.

The Coastal Plain is a region of sand, clay, and other soft materials, which lie on an eastward-sloping floor of granite and crystalline rock. The soils differ from those of the Piedmont in their loose structure, lack of loaminess, the predominance of sand, and the frequent occurrence of water worn gravel throughout the soil profile. For the most part the Coastal Plain consists of a wide plateau trenched by broad, terraced valleys of numerous streams.

The major portion of the two regions is well drained by several rivers and their tributaries. The most extensive drainage system is the James River which flows through the central part of the area, marking the boundary between Henrico and Chesterfield counties. The Appomattox River is the largest tributary of the James in this area. The drainage system to the north consists primarily of the North Anna, Little, New Found, Pamunkey, Chickahominy, and South Anna Rivers.

Materials and methods.—Soil samples were taken at forty-one stations, picked at random from the one hundred twenty-three stations visited during a survey of the land Mollusca of this area. This represented one-third of the total number of stations. At each of these stations where soil analyses were made all the snails found in an arbitrarily selected nine square feet of habitat

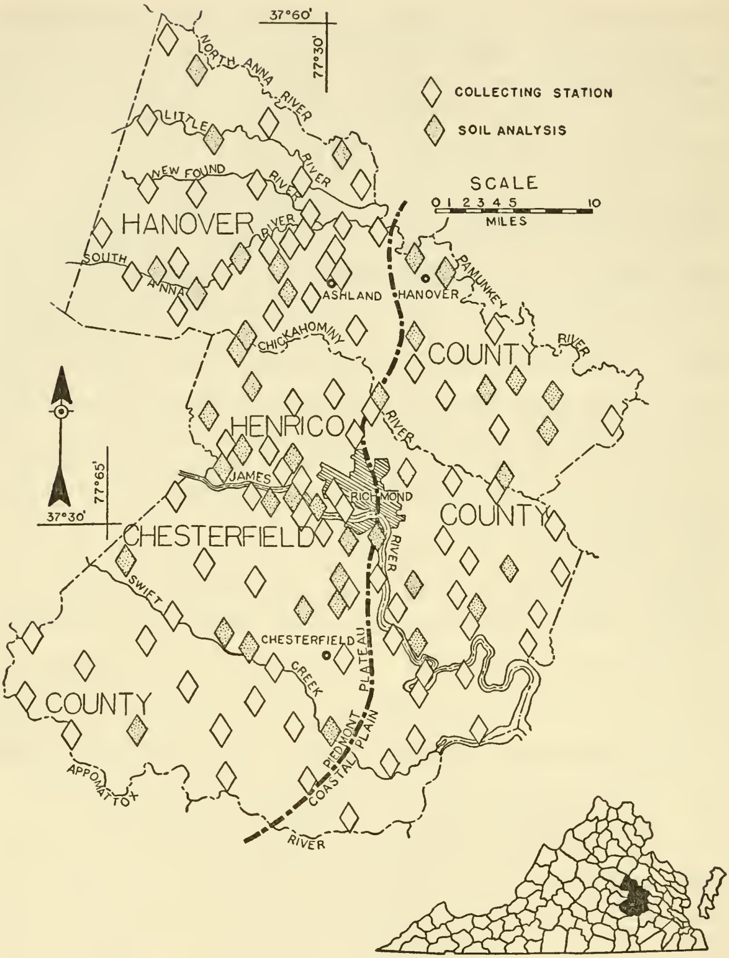

FIG. 1. Hanover, Henrico, and Chesterfield Counties, Virginia.

were recorded. A liter sample of soil and humus was taken and analyzed for organic matter, calcium (CaO), magnesium (MgO), potassium (K_2O), and phosphorus (P_2O_5) by the Virginia Agricultural Experiment Station, Blacksburg, Virginia. The data were recorded in terms of availability to plants, the amount extracted by a weak acid. A flame photometer was used for the determination of potassium and a photolometer for calcium,

magnesium, and phosphorus. The pH values were obtained by a Hellige colorimeter as soon as the samples were brought in from the field.

Analysis of soil samples.—The correlation between lime supply and abundance of land snails is close enough that collectors recognize the presence of limestone in the form of cliffs and outcrops as particularly favorable collecting stations. It is to be expected that snails would also be more abundant where calcium is richest in an area devoid of limestone, such as the area investigated in this study. The calcium obtained for growth in these habitats must come directly from the soil, organic materials of the humus, or from shells of other snails. The number of snails in this area was found to increase with the amount of calcium present in the samples, the greatest number of both species (Table I; Figure 2) and specimens (Table I; Figure 3) occurring where the available calcium content was 0.075 per cent or higher. No specimens were found in samples containing less than 0.019 per cent calcium.

Magnesium has been shown (Clarke and Wheeler, 1922) to be an important constituent of marine mollusk shells. It might also be expected essential for land snails. The correlation of magnesium (MgO) with land snail distribution was somewhat similar to that of calcium, the majority of the snails being found where the concentration was 0.018 per cent or higher. The number of snails also increased with an increase in the concentration of potassium (K_2O) and reached a maximum at a phosphorus (P_2O_5) concentration of 0.002–0.004 per cent, declining for higher concentration. The effect of these two compounds on snail distribution is probably indirect, being important in plant metabolism.

The importance of organic matter or food as a limiting factor in snail distribution has received some attention and Boycott (1929, 1936) and Oughton (1948) do not consider food, other than calcium, restrictive. Shimek (1930) is of the opinion that food is one of the prime factors in the distribution of land snails. In this investigation a close correlation was found between the amount of organic matter and presence of snails. Ninety-four per cent of all snails collected were found where the organic matter present in the samples was three per cent or greater, and

SPECIES	NUMBER OF SPECIMENS	pH						CALCIUM CaO				MAGNESIUM MgO				PHOSPHORUS P_2O_5				POTASSIUM K_2O				ORGANIC MATTER				NUMBER OF STATIONS
								L	M	H	VH	L	M	H	VH	L	M	H	VH	L	M	H	VH	L	M	H	VH	
		4.8 – 5.2	5.3 – 5.7	5.8 – 6.2	6.3 – 6.7	6.8 – 7.2	7.3 – 7.7	0.000-0.018 %	0.019-0.044 %	0.045-0.074 %	0.075+ %	0.000-0.002 %	0.003-0.008 %	0.009-0.017 %	0.018+ %	0.000-0.001 %	0.002-0.004 %	0.005-0.012 %	0.013+ %	0.000-0.003 %	0.004-0.007 %	0.008-0.011 %	0.012+ %	0.0-0.9 %	1.0-1.9 %	2.0-2.9 %	3.0+ %	
Anguispira alternata fergusoni	42		4		35	1	2				42		34	3	5		40	1	1			34	8				42	5
Carychium exiguum	35			17	18					5	30			11	24	7	12	16				18	17				35	6
Cionella lubrica morseana	5			5							5				5	5						5					5	1
Columella edentula	5		3	1	1						5			4	1		5					4	1				5	3
Euconulus chersinus	7			3	4					3	4			4	3	2	5					6	1				7	4
Gastrocopta armifera	14						14				14				14				14				14			14		1
Gastrocopta contracta	74			1	30	42	1			4	70			20	54	18	28	28			1	10	63				74	9
Gastrocopta pentodon	7			1	6						7				7		1	6					7				7	3
Haplotrema concavum	82		4	25	23	29	1			6	76		2	14	66	22	38	12	10		4	27	51				82	17
Hawaiia minuscula	61			3	33	14	11			1	60			8	53	2	12	35	12		5	1	55			11	50	11
Helicodiscus parallelus	144	5	28	32	53	9	17		3	27	114		8	64	72	17	91	25	11		20	53	71			3	141	32
Mesodon appressus sculptior	17			6	8	3					17			2	15	7	2		8			4	13				17	4
Mesodon thyroidus	28		2	11		15				5	23			9	19	2	26				1	13	14				28	8
Punctum minutissimum	5				5					3	2			3	2		2	3				3	2				5	3
Retinella burringtoni	56		1	6	31	18				16	40			20	36	8	30	16	2			25	31				56	13
Retinella indentata	90		7	20	40	21	2		1	19	70		2	25	63	12	36	38	4		6	32	52			1	89	24
Retinella rhoadsi	1				1						1				1				1				1				1	1
Stenotrema hirsutum	7			1	4		2			3	4			6	1		6	1				4	3				7	4
Striatura milium	21		1	5	11	2	2		1	11	9		1	14	6	3	12	6			4	13	4			1	20	14
Strobilops aenea	147	10	2	19	75	33	8		2	7	138		2	79	66	10	97	11	29		9	20	118			2	145	23
Strobilops labyrinthica	3				2	1				1	2			3				3			1	2					3	2
Triodopsis albolabris	2			1	1				1		1		1		1		2				1		1			1	1	2
Triodopsis fallax	34					26	8				34			26	8			26	8		26		8			8	26	2
Triodopsis hopetonensis	1			1							1			1			1						1				1	1
Triodopsis tridentata juxtidens	74			28	26	13	7		3	10	61		4	18	52	18	31	16	9		4	29	41		1	2	71	16
Vallonia excentrica	19						19				19				19				19				19			19		1
Ventridens suppressus magnidens	42		25	2	5	4	6		1	1	40		1	31	10		32	4	6		5	30	7			7	35	7
Ventridens ligera	30		8	5	2	15				6	24			10	20		28	1	1			9	21				30	6
Vertigo ovata	1				1					1				1			1					1					1	1
Zonitoides arboreus	425	14	17	59	115	182	38		1	52	372		16	156	253	61	268	39	57		12	81	332			20	405	34
TOTAL SPECIMENS	1479	29	102	252	530	428	138	0	13	181	1285	0	71	532	876	194	806	287	192	0	99	424	956	0	1	89	1389	
TOTAL SPECIES	30	3	12	22	24	17	15	0	8	19	29	0	10	24	27	15	24	19	16	0	14	23	27	0	1	12	28	

TABLE I. Frequencies of snails in relation to pH, calcium, magnesium, phosphorus, potassium, and organic matter.

very few where concentrations were less. Whether or not the organic matter present in the samples is significant as actual food material *per se* may be questioned, but doubtless it gives an indication of certain other environmental conditions.

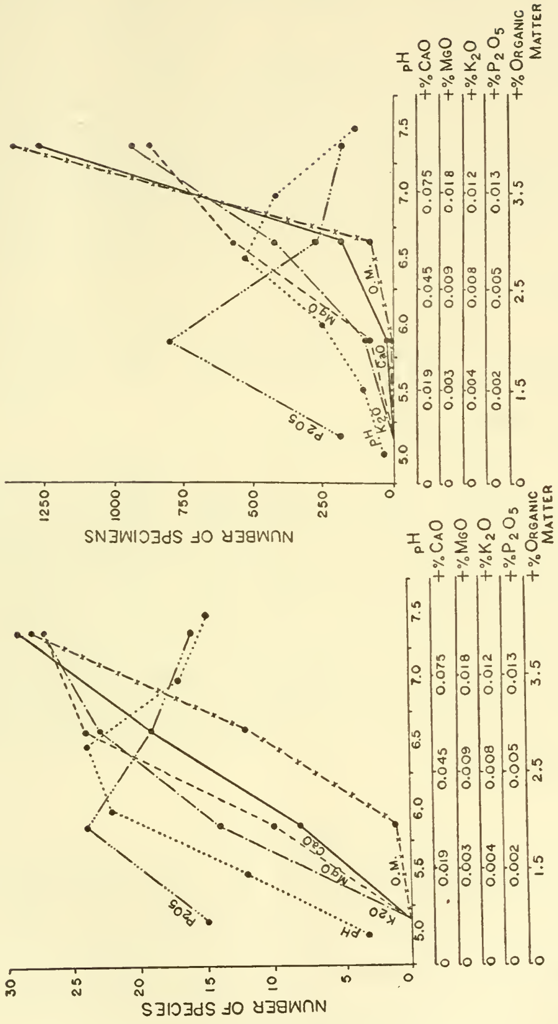

FIG. 2 (left). Total number of species in relation to pH and percentages of calcium, magnesium, potassium, phosphorus, and organic matter. FIG. 3 (right). Total specimens.

Studies on land snail distribution in relation to soil reaction have produced varying results (Jacot, 1940; Oughton, 1948; Atkins and Lebour, 1923; Ökland, 1930; Archer, 1939; Strandine, 1941; Lee, 1952; Burch, 1955). Land snails in this area were found to occur at pH ranges of 4.8–7.7, and most frequently at a pH range of 6.3–6.7. It is the opinion of this investigator that pH is not a limiting factor in their distribution and probably has scarcely any influence. The occurrence of snails within certain pH ranges can be related to numerous conditions other than soil reaction, such as physical makeup of the soil, content of available nutrients, and influences of climate and vegetation.

Summary.—1. Samples of soil and humus from forty-one stations where land snails were collected were analyzed for organic matter, certain inorganic compounds, and hydrogen-ion concentration.

2. Snails were found to increase with increase in concentrations of calcium (CaO), magnesium (MgO), potassium (K_2O), and organic matter. They were found in greatest abundance at a pH range of 6.3–6.7 and where the phosphorus (P_2O_5) concentrations were between 0.002 and 0.004 per cent.

3. The primary conditions of the soil, other than moisture and the provision of cover, which limit the distribution of land snails in this area appear to be calcium, magnesium, and organic matter. Potassium, phosphorus, and hydrogen-ion concentration may have some indirect effect but are assumed not to be limiting factors.

Acknowledgments

I wish to acknowledge the aid of Dr. N. E. Rice, University of Richmond, for advice and criticism, and Dr. C. I. Rich and Mr. W. W. Lewis, Virginia Agricultural Experiment Station, for analysis of and information concerning soil samples.

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THE MOLLUSKS OF WARM SPRINGS, GEORGIA

By MARGARET C. TESKEY

"Warm Springs (Merriwether County), Georgia; population 557, elevation 930 feet. Site of the Warm Springs Foundation Hospital for Infantile Paralysis. Part-time home of President Franklin Delano Roosevelt which he loved and where he died." So reads the guidebook. In the study of the late president in the Little White House (now open to the public) two shelves are crowded with books written on all phases of

his life in this obscure village as well as in the world outside it. Several describe the area in detail, yet it is safe to assume that no one of them records the molluscan denizens of Warm Springs.

An opportunity was afforded to collect there during the final two days of June, 1955. The following stations were investigated, all in the immediate vicinity of the village: (1) grounds of the Foundation hospital, wooded and clogged with undergrowth; (2) forest on slope at base of Pine Mountain fire tower; (3) open field nearby, beneath pile of rotting plaster sacks; (4) Dowdell's Knob, scenic lookout, outcropping of granite boulders on mountain top, occasional rotting log; (5) Cascade Falls, leafmold on loose shale; (6) Parkman Pond, detritus in crannies of stone walls and rotting timbers of old mill; (7) state fish hatchery; (8) cattail swale at edge of man-made pond.

Search in several brooks draining the so-called warm springs was unrewarding. One faunistic detail might be mentioned: at the first four stations, scorpions outnumbered the snails two to one. This collector who works best in prone position learned early in the day to first clear away elbow space.

I am indebted to Mr. Ralph W. Jackson who identified the land material, to Dr. Henry A. Pilsbry who helped out on two specimens which Mr. Jackson found puzzling, and to Dr. William J. Clench who identified the Physidae.

Following is a list of twenty-three species taken together with the stations at which they occurred:

Stenotrema stenotrema Pfr. 2, 6
Stenotrema maxillatum Gould 5
Praticolella lawae Lewis 3
Mesodon thyroidus Say 6
Mesodon inflectus Say 2, 6
Mesodon perigraptus Pils. 6
Triodopsis albolabris major Binn. 2, 3
Triodopsis vannostrandi Bland 2, 3
Euconulus chersinus Say 4, 5
Retinella indentata Say 5
Retinella indentata paucilirata Morel. 1, 2, 4, 5, 6
Mesomphix vulgatus H. B. Baker 1, 6

Mesomphix pilsbryi Clapp 2, 4
Gastrodonta interna Say 2
Ventridens intertextus Binn. 2
Ventridens gularis theloides Walker & Pils. 2, 4
Zonitoides arboreus Say 6
Helicodiscus parallelus Say 5
Succinea avara Say 5
Strobilops labyrinthica Say 5, 6
Vertigo ovata Say 8
Vertigo rugosula oralis Sterki 6
Physa crocata Lea 7

AMERICAN MALACOLOGICAL UNION

Twenty-first Annual Meeting, July 26th–29th, 1955

By MARGARET C. TESKEY, Secretary

It was a combination of organizations and individuals working together which made the 1955 meeting an unqualified success. Wagner College on Staten Island, New York, began by providing a new dormitory, dining hall and meeting room, even a spacious porch for lounging and quiet talk. And as though such generosity was not enough, tendered a gracious tea on the evening of opening day. The Staten Island Museum opened its doors for an entire day, providing meeting facilities for two sessions and a bountiful luncheon at noon. And finally, the co-host New York Shell Club was represented by A.M.U. President M. K. Jacobson and his right-hand team Mr. and Mrs. Anthony D'Attilio who were everywhere at once, overseeing the thousand-and-one details which entertainment on such scale always brings forth.

About eighty members and their guests attended the meeting representing eighteen states, the District of Columbia, Puerto Rico and the Philippine Islands. It was hot in New York, but hot too over the rest of the nation and Wagner's hilltop site brought cooling breezes each evening. As the stars came out so did the delegates, out upon the great stone porch to rest,

to chat and watch the lighted ships as they passed up and down the Narrows far below.

At the annual business meeting the following officers and councillors were elected to serve for the next twelve months: President, Allyn G. Smith; Vice-president, Ruth D. Turner; 2nd Vice-president, Edward P. Baker; Secretary-treasurer, Margaret C. Teskey; Publications Editor, George M. Moore; Councillors-at-Large, R. Tucker Abbott, Ralph W. Jackson, Katherine Van Winkle Palmer, Juan J. Parodiz.

The scheduled program clicked off as the days passed: registration-reunion the morning of opening day; scientific sessions, two each day; two field trips; the annual dinner followed by a rib-tickling skit (one snail to another!) and movies by Dr. William H. Loery, filmed on Guam with living mollusks in leading roles.

Then it was over for another year. Who can say which brings greater joy—remembering the past or planning for the future? Future A.M.U. meetings, of course.

NOTES AND NEWS

ALDERIA MODESTA IN WASHINGTON.—Since preparing the paper on this nudibranch in July NAUTILUS I had an opportunity to spend some time on San Juan Island, Washington. There I discovered in a *Salicornia* marsh at Garrison Bay numerous specimens of *Alderia modesta.* This then extents the distribution of this nudibranch on the American West Coast from Central California to the Canadian border.—C. HAND.

MR. JOHN Q. BURCH 1584 W. Vernon Ave., Los Angeles 62, is now assembling names, addresses and interests for the 1956 Directory of Conchologists. Free listing.

A CORRECTION.—Dr. Pilsbry has kindly brought to my attention an error in the name of a Miocene fossil species of Cyclophorid land snail from the Bowden Beds of Jamaica. The name *Cyclochittya schermoi* Morrison (Journ. Wash. Acad. Sci. 45 (5): 154, May 1955) should be corrected to *C. schumoi.* The name of the collector was Silas L. Schumo.—J. P. E. MORRISON.

THE NAUTILUS

Vol. 69 JANUARY, 1956 No. 3

OBSERVATIONS OF PREDATION ON ECHINODERMS BY THREE SPECIES OF CASSIDIDAE

By DONALD R. MOORE

Gulf Coast Research Laboratory, Ocean Springs, Mississippi

Recorded observations on living cassids are rare in the literature and the writer has found nothing in a search of the common works on the feeding habits or prey of these gastropods. The following observations were made during the course of several years diving in Florida waters.

In the spring of 1949, a collecting trip was made with Gilbert Voss and Frank Lyman to the Florida Keys. On the morning of May 13th, just north of Conch Reef, a large colony of *Cassis madagascariensis spinella* Clench was sighted on clean sand bottom in about twenty feet of water. This subspecies seems to be limited to the Florida Keys (Clench, 1944, p. 16).

Some individuals were crawling on the bottom while others were buried to a depth of six inches or more. Upon investigation it was found that they were feeding on heart urchins that live buried in the sand. Mr. Voss later identified the urchin as *Plagiobrissus grandis* (Gmelin). It is a large species attaining a length of more than 200 mm. This is one of the most beautiful of the heart urchins and has been considered quite rare by specialists on West Indian echinoderms. This apparent rarity is probably due to its penchant for slightly deeper water than other littoral echinoderms and to a very spotty distribution. Where it is found, however, the colony may consist of many individuals. Clark (1919, p. 62) states that it is common near Nassau, Bahamas, but reliable records from elsewhere are rare.

The test of *P. grandis* is white, thin, flattened and very graceful in outline. Clark (1917, p. 207) states, "no ecinois so well deserves the name *grandis* as does this magnificent spatangoid. When in perfect condition with all its long, dorsal primary

spines intact, it is certainly the handsomest and most remarkable of shallow water spatangoids."

Several *Cassis* were observed as they located a buried urchin. They burrowed down at a rather steep angle and ploughed through the sand to their prey. Several shells that were almost buried were removed with urchins clasped in the fore part of the foot. One urchin that had escaped was seen trundling along on its short secondary spines with a large *Cassis* in hot pursuit. Evidently this was an exception, as no other fugitives were seen. The result of the chase was not observed but the heart urchin seemed to be making good his escape.

An examination of one of these urchins from which the gastropod was removed showed that an area of approximately 25 mm. in diameter had been cleared of spines. In this area there was a neatly drilled hole through the thin test. One specimen, which was placed in The University of Miami Marine Laboratory Museum (specimen No. 42: 33) has a hole 9 mm. in diameter in the antero-lateral edge.

Most of the *Cassis* were large or very large and fully mature. The largest specimen taken was nearly fourteen inches long (approximately 350 mm.). A specimen collected a few miles north of Conch Reef in 1952 measured 300 mm. long by 230 mm. wide by 185 mm. high. This is by no means a giant but seems to be average size for the adults.

One hundred and fifty *Cassis* were counted and probably twice as many more were seen. The author has found other Western Atlantic species of this genus, but never in large colonies.

In June, 1950 the author, while following the edge of a reef, observed another member of the genus in the act of feeding. The empty tests of several sea urchins provided an easily followed trail, at the end of which was a *Cassis tuberosa* (L.). It was eating a large white sea urchin, *Tripneustes esculentus* (Leske).

This handsome sea urchin is dark with white spines; the test is circular in outline, but slightly depressed. Since it lives out in the open, it has been taken much more frequently than has *Plagiobrissus grandis*. It is fairly numerous in some localities, but individuals are usually well scattered.

Cassis tuberosa appears to be a solitary species. This colorful gastropod is usually found living on reefs where a supply of

sea urchins is always at hand. The author has never seen this species except as single individuals.

In July, 1954, while examining the sea bottom about two hundred yards off Pensacola Beach, Florida, the author found a great concentration of the sand dollar, *Mellita quinquiesperforata* (Leske). These echinoids are greatly flattened and have secondarily acquired bilateral symmetry. Since they live in a zone where large waves exert considerable force, they have many partitions and columns which strengthen the test. Five holes near the outer edge serve to strengthen the test also. They were most numerous where the water was about twenty feet deep. Here and there, they were so crowded that they overlapped, with a density of more than ten per square foot.

At first, *Mellita* appeared to be not only the dominant organism, but the only one present. However, a search revealed the presence of the sand dwelling gastropod, *Oliva sayana* Ravenel. Three live *Phalium granulatum,* the Scotch Bonnet, were also found, each one perched on a *Mellita.* When these were removed, a small hole was revealed near the center of the test of each echinoderm. The holes were a little less than two mm. in diameter, but since the test of the sand dollar has a rather porous structure, the teeth of the radula did not leave any distinctive marks.

Apparently, the sand dollar is a dominant organism in a rather narrow zone just offshore along much of the Gulf coast. Off the Texas coast, where the water is very turbid, this is the most common animal to be found in fifteen to thirty foot depths. In slightly deeper water, *Mellita* is replaced by another sand dollar, *Encope michelini* (Agassiz). Whether or not this species also serves as food for the Scotch Bonnet, remains to be determined.

The members of the family Cassididae are carnivorous and thus are normally solitary individuals. Although further observations are needed, it is perhaps significant that each of the three species discussed in this paper was found feeding on three different types of echinoids in slightly different habitats. The zones of these echinoids apparently overlap little, if any.

Probably the concentration of *Cassis madagascariensis spinella* off Conch Reef was due to its selective feeding habits. There must have been a large colony of heart urchins at this locality,

as shown by the number of empty tests lying around. This local abundance of food was probably the cause of the grouping of so many of these large predatory gastropods in such a small area.

Although numerous at Pensacola Beach, the sand dollars were actually part of a vast population extending for many miles along the Gulf coast. Since there is no local concentration of these animals it would be logical to find *Phalium granulatum* well scattered. The author's observations indicate that this is apparently the case.

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NOTES ON THE STINGING OPERATION OF *CONUS*

By GEORGE F. KLINE[1]

While collecting on the "Gloria Maris" expedition in the Palau Islands, Western Caroline Group, during the summer of 1955, we had several opportunities of observing specimens of *Conus* stinging their victims. Much has been written regarding the effects of the venom of *Conus* and the apparatus by means of which it is injected, but to our knowledge no observations have been recorded of the actual behavior at the moment of attack.

Several species were used in our experiments, but only two performed in captivity—*Conus auratus* Hwass and *textile* Linné. One of the chief problems was to find some means to stimulate the animal to attack. Most cones are quite retiring, and some of the renowned venomous species, such as *Conus marmoreus* Linné, *striatus* Linné, *tulipa* Linné, and *geographus* Linné, refused to perform in our aquaria. In fact *marmoreus* would not even emerge from its shell.

Conus auratus and *textile* seemed to be quite aggressive, and would obligingly crawl about whenever placed in fresh sea

[1] Research supported by the Natural Science Foundation, Philadelphia, Pa.

water. It was found that if the shell was held, aperture up, and a few drops of fresh water or saliva allowed to drip on the retracted animal, it would produce results rather quickly. If the specimen was replaced in the sea water, its brilliant red proboscis would immediately be thrust out in an exploratory manner. At this stage, the proboscis is quite evenly tapered from base to tip, and would be moved about in a deliberate, sinuous manner. The proboscis can be extended to about three quarters of the length of the shell—thus a two-inch specimen can "reach out" to about a length of $1\frac{1}{2}$ inches.

If, while in this state of excitement, suitable prey was placed nearby, the cone usually stung fairly promptly. The moving proboscis would "discover" the soft parts of, say, a *Cypraea*. There seemed to be an immediate heightening of excitement when the desirable location on the victim was found. The tip of the proboscis was brought stationary at this point, and a quick spasm of the whole proboscis immediately ensued, with obvious thrusting pressure. It became momentarily rigid and turgid, although usually in a curving rather than a straight line. Simultaneously with the muscular spasm and thrust, a small milky cloud appeared around the point of contact, and the proboscis then was quickly withdrawn, still emitting a small amount of the milky fluid. The cloud reached a diameter of about one fourth to one half inch before it dissipated itself in the water. Having executed its sting, the cone seemed to lose interest in the prey. On several occasions the small, glass-like barb was seen protruding from the victim following the striking operation.

One of the most interesting occurrences was the lethal stinging of *Conus geographus* by a *C. textile* about one-third its size. Several *textile,* ranging from two to two and one-half inches in length, were placed in a container of sea water with a four-inch long *geographus.* Without any special stimulus one of the smaller *textile,* which crawled close to the moving *geographus,* instantly shot out its proboscis and stung the foot of the latter. A few moments later a second *textile* made a similar strike and within five minutes the *geographus* was limp and evidently dead.

Several species of "victims" were tried. The cones would not sting *Oliva* or *Nassarius,* but readily responded when *Cypraea* was offered. Small species of *Cypraea* were killed by one or two

stings; larger ones, such as *Cypraea tigris* Linné, seemed able to absorb more of the venom and still live, although they obviously became seriously affected.

REMARKS ON I. BORN'S INDEX RERUM NATURALIUM MUSEI CAESAREI VINDOBONENSIS, 1778

By R. F. RUTSCH

University of Berne

DODGE in his valuable "Historical Review of the Mollusks of Linnaeus" (1952, 1953) refers to two publications of IGNATIUS BORN,[1] the "Index rerum naturalium Musei Caesarei Vindobonensis" and the "Testacea Musei Caesarei Vindobonensis" and states (1952, p. 231; 1953, p. 125):

"The 'Index' of Born, which bears the date 1778 on its title page, was not published until 1780. His 'Testacea' bears the date 1780 on its title page and was published in that year. The latter is a folio volume and is not a second edition of the 'Index.' It is limited to Mollusca. The two works were, however, prepared simultaneously as they quote each other."

This is certainly incorrect. The Library of the University of Berne has a copy of the "Index" with the handwritten comment of J. S. WYTTENBACH (one of the founders of the Swiss Society of Natural History), that he received this copy in 1779. Moreover BRAUER (1878) in his publication on IGNATIUS BORN cites 1778 as the date of publication of the "Index." We have therefore no reason to doubt that BORN's "Index" was really published in 1778.

Several living East American species such as *Phalium granulatum* (BORN), *Ostraea cristata* (BORN), *Dosinia concentrica* (BORN), *Tivela mactroides* (BORN), etc. date from 1778 and not from 1780 as often stated in American conchological literature (e.g. JOHNSON 1934, CLENCH 1944, etc.).

I wish also to draw the attention of American conchologists to the fact that according to BRAUER (1878) many of BORN's types are still preserved in the Zoological Museum at Vienna.

[1] IGNATIUS BORN (1742–1791) was curator of the "Kaiserliches Naturalienkabinet" of Vienna from 1776 on.

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WATER CIRCULATION IN THE MANTLE CAVITY OF THE OWL LIMPET LOTTIA GIGANTEA GRAY

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On the Californian coast the owl limpet, *Lottia gigantea* Gray, occurs on intertidal rocks in and above the mussel beds in areas where wave action is often severe. The anatomy of this form is well known through the work of Fisher (1904). As in other members of the Patellacea, the mantle cavity includes not only the nuchal cavity lying back of the head, but also the pallial groove surrounding the body. In *Lottia* the pallial groove bears a cordon of secondary gills consisting of lappet-like outgrowths of the mantle (Figs. A, C). This ring of gills is in-

complete anteriorly, and is poorly developed or absent in individuals less than about 20 mm. in length (Fisher, 1904). The nuchal cavity bears the single left ctenidium; this is oriented such that the efferent (''ventral'') vessel lies toward the left side, and the afferent (''dorsal'') vessel is directed toward the right (Figs. A, B). Afferent and efferent suspensory membranes are virtually absent.

The pallial water currents produced by *Lottia* have never been reported, though Yonge (1947) has predicted the probable circulation of water in this genus from a study of living representatives of the related limpets *Helcion* (*Patina*), *Patella*, and *Acmaea* (*Patelloida*). He notes that ". . . the presence of the ctenidium indicates . . . an inhalant current on the left of the head. The pallial gills presumably produce diffuse inhalant streams into the pallial grooves, while conditions in *Patina* indicate the probability of a sediment-laden exhalant current on the right of the head'' (Yonge, 1947, p. 472, and Fig. 23 B). These predictions have proved substantially correct.

In the present study ciliary currents in *Lottia* were observed in living intact individuals immersed in seawater containing a small quantity of suspended carmine. Some individuals were attached to upright or inverted glass plates; other animals were inverted unattached. Additional observations were made on living animals in which the anterior portion of the shell was removed and the nuchal cavity laid open.

The ctenidium resembles that of *Theodoxus* as described and figured by Yonge (1947, p. 476 and Fig. 18 B); it differs in appearing somewhat more regularly elliptical in cross-section, and in having very active lateral cilia distributed all over the flat surfaces of the filaments instead of being confined to definite bands. Circulation in the nuchal cavity results largely from the beating of these lateral cilia on the filaments. Water enters the nuchal cavity on the left side, passes between adjacent filaments above and below the ctenidial axis, and exits on the right side accompanied by waste materials from the anus and renal apertures (Fig. B). In addition, there are powerful ciliary currents on the posterior head and neck which sweep from left to right. The roof of the nuchal cavity shows very little ciliary activity.

In contrast to the water currents of the nuchal cavity, those of the pallial groove are rather weak. The mantle margin in the

region of the sensory tentacles shows little or no ciliary activity. The remainder of the flat mantle surface and the basal portions of each pallial gill possess incurrent ciliary tracts. The erect surfaces of the pallial gills bear ciliated areas that carry materials toward the free margin of the gill (Fig. C). The sides of the foot and body which form the inner wall of the pallial groove show almost no ciliary activity. Sediments entering with the inhalant current tend to accumulate along the mantle margin and along the side of the foot, trapped in a layer of mucus. In a moving animal this material is left behind with the mucous trail; in stationary individuals it is expelled not by ciliary action but by irregular muscular movements of the animal. Proper determination of the ciliary currents of the pallial groove is rendered more difficult in bigger individuals by the presence of large numbers of both attached and free-moving ciliated protozoans on the mantle and gill surfaces.

The functional significance of the ciliary currents is not entirely clear from laboratory studies of owl limpets attached to glass plates. For one thing, the anterior margin of the shell in *Lottia* is usually curved downward, making it impossible for the animal to seal itself tightly to a smooth flat surface. On such a surface the lateral margins of the shell remain slightly elevated, and even when the animal is firmly clamped down, the shell may be rocked slightly from side to side. This shell condition is rather consistent regardless of the substrate form, though the nature of the modification is somewhat similar to that noted by Comfort (1946) in *Patella* growing on mussels or umbonate rocks. On a flat rock this shell-form would insure an opening through which water could always be drawn into the pallial and nuchal cavities at high tide. However, the presence of such a groove is not in consonance with the commonly held picture of a limpet clamped to a perfectly-fitting home scar at low tide to prevent water loss from the pallial complex. Numerous questions arise: Is the pallial groove open to the outside or sealed off at low tide? At low water is the pallial groove filled with air or water? How does wave action affect water movement in the mantle cavity? Field observations of *Lottia* have been made at various phases of the tidal cycle. These have provided some interesting and somewhat unexpected answers to the above and related questions.

At Mussel Point, Pacific Grove, California, *Lottia* occurs on surf-beaten rocks in the intertidal zone from the 0.0 datum line to about 4.0 ft., the great majority of the individuals being found within the range of 0.5 to 3.4 ft. (Hewatt, 1937, Pl. 1). Occasional individuals occur higher in crevices or in areas where wave splash is great. In southern California, *Lottia* is said to occur a bit higher in the intertidal (Rasmussen, 1935; Ricketts and Calvin, 1952). The upper limit of *Lottia* coincides remarkably well with the 3.4 ft. height reached by the very lowest of the lower high waters in this region (Ricketts and Calvin, 1952, Figs. 1, 132). Animals below this level are never exposed for periods longer than about 10 hours, and are always covered by the tides twice each day. Above this level, the forms present may be covered by the sea only once in 24 hours during equatorial tides, and the maximum period of continuous exposure extends abruptly to about 18 hours.

During periods of low water *Lottia* is generally inactive. Some individuals are found occupying distinct "home scars" which fit the shell margin very well. Frequently, however, there is no clear scar below or near the animal, and the shell margin does not conform very well with local small irregularities of the granite. Where scars are present, these are usually nearly as well covered by an algal film as the adjoining rock surface, suggesting that individuals of *Lottia* are often away from home. Probably, as in *Patella*, the homing habit is not so well developed in individuals living on a relatively even substrate, and the animals may not remain in the same place for long periods (Orton, 1929; Jones, 1948).

Many *Lottia* have been examined closely at low tide. With few exceptions these show the following features. First, the shell, while it rests lightly against the substrate, is seldom clamped firmly down. Especially along the lateral margins there usually remain slight gaps between shell and rock. The mantle often protrudes slightly in these areas, and here and there are places where a narrow open communication exists between the pallial groove and the outside. With the shell muscle slightly relaxed, an air space is present in the pallial groove, and the ciliary currents described earlier are probably effective in circulating the surface film of moisture over the mantle and pallial gills. When disturbed the animal clamps firmly down;

this reduces the volume of the nuchal cavity and compresses the pallial groove to a mere slit, eliminating the air space and often squeezing a bit of water out at the shell edges as well. Subsequent relaxation again opens the pallial groove and draws air in under the shell. It appears, then, that at low water the pallial groove contains a sizeable air space, that under these conditions the pallial gills and relatively vascular mantle are wet but exposed to air, and that these ciliated structures probably play a primary role in aerial respiration. Openings to the outside are so small that desiccation is probably no problem, for exposures to air never exceed 10 hours and are usually of a shorter duration. The pallial groove and nuchal cavity contain considerable residual water, and any surfaces tending to dry out could be wetted by an occasional slight contraction of the shell muscle. Such movements might also help ventilate the pallial cavity, though this would not appear to be necessary.

Observations of limpet behavior when the tide is in are by no means so easy. However, with the aid of binoculars, good observations were obtained on a total of 18 *Lottia* which were being regularly pounded and exposed again by the waves at intermediate water levels. Six animals were watched during tidal ebb, and twelve during tidal flow. The findings were somewhat surprising to one accustomed to thinking of limpets as tightly drawn to the rocks in pounding seas. With only two exceptions, all of these individuals had their shell margins elevated an estimated distance of two to six mm. above the rock surface, leaving the pallial groove broadly open to the surging waters all around. Thus with every wave the pallial cavities and grooves were flushed with a torrent of water, and even in the full force of the waves the shell was not clamped to the rock surface, though the animals were stationary. It seems clear that at this phase of the tide, the real work of circulating water through the pallial complex is accomplished not so much by ciliary activity as by the action of the sea itself. No observations have been carried out during the highest waters, for the animals are then fully and continuously submerged and the rocks scarcely approachable. Under conditions of full submersion it would seem that the respiratory effectiveness of the ctenidium would reach its peak; in contrast, the pallial gills would appear to be able to operate effectively regardless of the height of the water. This is of

interest in view of the series one finds in the Patellacea: *Acmaea* with ctenidium only, *Lottia* with ctenidium and pallial gills, and the Patellidae with pallial gills only.

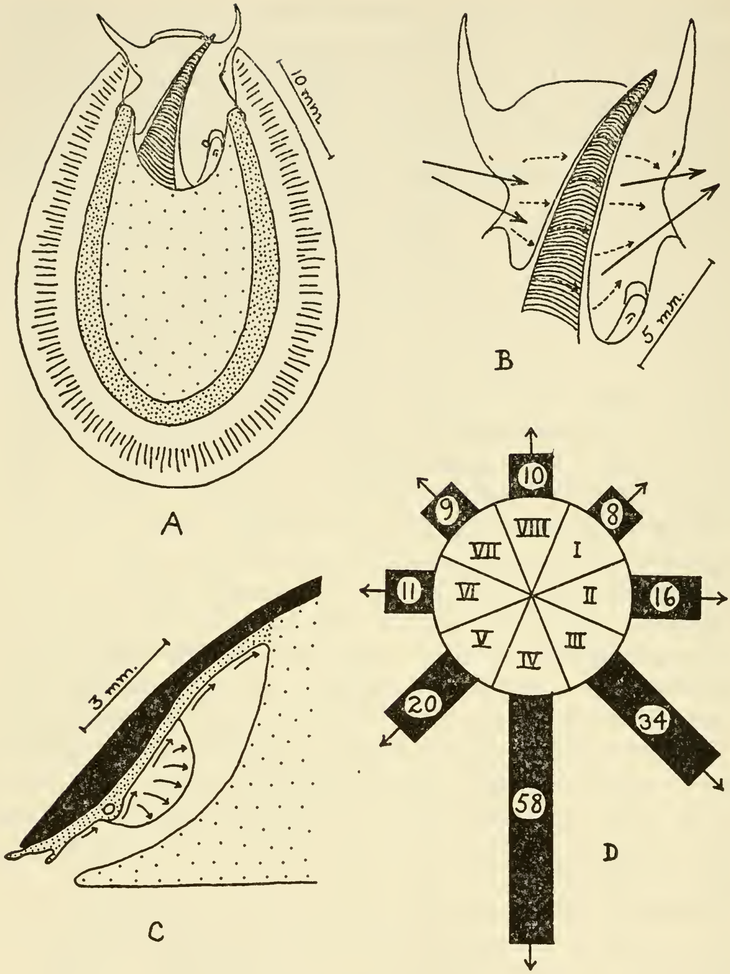
The vast majority of *Lottia* are found clinging to steeply sloping or vertical surfaces of rock in central California. During the tidal periods when they are being wetted by the sea, they are subjected to moving water coming from various directions. The most persistent water flow, however, is from above, consisting of waters draining down the surface of the rock. It is apparent that the current of water down the face of the rocks and around animals whose shells are slightly raised, might serve either to reenforce or to counteract the action of the ciliary currents, particularly those of the nuchal cavity, depending on the orientation of the individual animal on the rock. If the anterior end of the animal, as viewed from the dorsal surface, is directed to the right or downward (from about 2 to 5 or 6 o'clock), the water runoff would tend to supplement and reenforce the ciliary currents of the nuchal cavity and flush wastes away from the ctenidium. For animals with the head pointed upward or inclined toward the left, the reverse would be true, and these individuals would appear to be at some disadvantage.

Orientation of the body on the rock surface was plotted for 175 animals. Of this number, 9 were on approximately horizontal surfaces, the remaining 166 on rather steeply sloping or vertical rock faces. Distribution of the 166 individuals into 8 classes on the basis of body orientation is shown in Fig. D. Very clearly there is a tendency for the animals to orient with their heads more or less downward, and a Chi-square test indicates the odds are less than one in 10,000 that such a distribution of orientations is due to chance alone.

If we omit, for the moment, animals with heads pointing either up or down (octants IV and VIII, Fig. D) and consider the remainder, the tendency for the animals to orient with the head to the right rather than to the left is by no means so clear. While a total of 58 individuals were assigned to the right-facing group (presumably advantageous octants I–III), and only 40 to the left-facing group (presumably disadvantageous octants V–VII), the difference here proves only of borderline or dubious statistical significance (5% level). Such a difference is suggestive but scarcely conclusive.

The real and significant tendency seems to be to keep the head down. This finding agrees in general with that of Wells (1917), who found positive reactions to gravity and "the current made by the waves" in five species of limpets including *L. gigantea.* Over one-third of the present animals have the head pointed almost straight downward, while fully two-thirds fall into octants III–V. In these animals, the ciliary currents of the nuchal cavity would be slightly helped, slightly hindered, or relatively unaffected. The possible advantages of the head-downward position would appear, on speculation, to be at least two-fold. First, this position affords the best drainage from the nuchal cavity of contaminating renal and fecal wastes. Pointing the head toward the right would be better than to the left, but head downward would be best under conditions of exposure at low water. With any significant downflow of water on the rock the sanitary problem would be negligible. Second, with the head down, water trapped in the mantle cavity at ebb tide would tend to drain toward the anterior end, where a deep recess underlies the beak of the shell. Thus under any conditions where desiccation might become a problem, the head and nuchal cavity bearing sense organs and ctenidium would be the last structures to suffer from drying. It seems doubtful that orientation would make much difference as far as deflecting the force of oncoming waves is concerned. The shell is low, offering little resistance to water coming from any direction, and, to an animal which can cling firmly in pounding seas with its shell raised almost like an umbrella above the body, this should be a negligible factor.

Summary: Ciliary currents in the nuchal cavity and pallial groove of *Lottia gigantea* are described and figured; these confirm earlier predictions of Yonge and add details. Studies of *Lottia* in the field indicate that the pallial gills serve as organs of aerial respiration at low tide, that wave action is the primary moving agent in water circulation at intermediate water levels, and that *Lottia* tends to orient on sloping rock surfaces with the head downward.



EXPLANATION

FIG. A. Dorsal view of *Lottia gigantea* Gray with the shell removed and the mantle cut away anteriorly to show the head and structures in the nuchal cavity. The horseshoe-shaped shell muscle is heavily stippled. Lateral to this the positions of the pallial gills below the mantle are indicated by short black lines.

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FIG. B. Dorsal view of the head and nuchal cavity with the mantle removed. Solid arrows indicate the main flow of water through the cavity. Dotted-line arrows show ciliary currents on the head, neck, and ctenidium.

FIG. C. Cross-section through the shell, mantle, pallial groove, and adjacent body and foot in the mid-body region. Arrows indicate ciliary currents on the flat mantle surface and pallial gills.

FIG. D. Graph showing orientation of individuals of *Lottia gigantea* on steeply sloping or vertical granite surfaces at Pacific Grove, California. Arrows indicate direction of the anterior end. Arabic numerals and black bars show the number of individuals observed whose orientations were assigned to each octant.

TWO ANONYMOUS LETTERS

Dear Dr. Curator:

With the current interest in all phases of natural sciences, with more and more people travelling each year, with increasing knowledge of the sea and its abundant life, the ranks of shell collectors are growing by leaps and bounds. Perhaps one should say by "stoops" and "dunks" as generally the novice starts by beachcombing.

From here the next phase can be illustrated by watching a hypothetical Mr. X who in all innocence has gathered a few shells on his vacation. He pockets a dozen or so and they find their way into his homeward bound luggage. The next step is a critical one for him. If he ceases to be interested in his bag or box of shells when his vacation has passed, all well and good, but if he so much as questions the name of one small mollusk he is in danger of starting on a hobby that can become intriguing, rewarding and time-taking.

As the years slip by Mr. and Mrs. X realize that their hobby has brought them much more than a collection of sea shells. They have covered a considerable area in pursuit of mollusks, bounded only by economic considerations. Their horizon has broadened as their travels have introduced them to people and customs they might never have encountered had they not become members of the shell collecting group. Interest in one aspect of natural science has brought with it an awakening to other forms of nature; with each new awareness they have gained immeasurably as human beings. They have learned that any pleasure is deepened with a fuller understanding of the subject. Our couple has become sincerely interested in conchology. They have purchased serious volumes on shells, have visited museums, and have met others who share their interest. No longer do beach specimens have the power to charm them—shells from the living animals are now their aim. Gradually the X's realize that their shelling trips might in some way be helpful to the scientists in the museums. Is there any way *they* can contribute to this great renaissance?

At this point our imaginary couple becomes real and joins the group of collectors who exist in substantial numbers. Many of us are in that odd position of an amateur status but advanced

enough that the language of the scientist no longer seems strange. We can understand reasonably well a lecture or an article on mollusks. We have a sincere wish to contribute something and we think we can. How and what and where, are the big questions. Through education and more aggressive public relations work on the part of museums the public is more and more aware that with intelligent cooperation our great institutions can become even greater. Statistics prove that globe trotting is widespread and growing and there seems to be ample proof that many of the "trotters" are collectors. There must be some way for the museums to capitalize on this state of affairs. It is at this point that the non-professional is apt to flounder. The intelligent collector knows that he can help. The question is *how?*

We all know that the scientist has said in as many ways as there are scientists "Shells with proper data are welcome additions to any scientific collection." Right here Dr. Curator, is where we need your help. Just what do you mean by proper data? You tell us to keep good and accurate field notes. Specifically what, in your opinion, IS a good set of field notes? We ask you what kind of shells you would be particularly interested in having from Idyllic Reef and you say "Bring any you can". Seriously, do you mean you really want a basket full of, say, Neritas, or should we try to bring a representative group of shells from a particular locality? Another question, learned Dr.—Do you want shells with opercula or not? If the answer is "yes," do you mean that you want each shell with its individual operculum, or do you mean for instance, fifty Neritas from one station with a bag of their fifty opercula collectively? And still another question—Are you interested in pictures or descriptions of the living mollusks? Does a description of any interesting characteristic behavior mean anything? For example—would you like to know that on several occasions it was observed that a particular species cut off part of its body when disturbed? Does it interest you to learn that some species described as "rare" in certain recognized publications proved quite common once the idea of "fanning" (stirring with the hand or a swim fin to sweep the sand away) for them was tried? Would you want any record of population in certain species? Would it be of any significance to record that particular varieties are considered a gastronomical delicacy on a certain island?

The questions could go on and on, but these few will illustrate our quandary. You see, Dr. Curator, we are serious in a desire to help you, we earnestly want to do a good job. We're in the hemi-, demi-, semi-, state of being a bit above the amateur in the strictest sense of the word and are conscious that we have a long way to go to rank with the professional, but, Dr. Curator, we're a mighty big group and you have created us—the next move is up to you.

How 'bout straightening us out?

(signed) A Collector

Dear Mr. and Mrs. Collector:

Your quandary is not limited to the legions of serious amateurs who wish to add to the knowledge of mollusks, but is a dilemma which faces any scientific observer, professional or otherwise, who goes into the field to pry into nature's secrets. The amount and types of data to be made are in direct proportion to the observer's training, interests and experience, but practical matters, such as time, money, equipment and physical endurance, will, in the end, dictate the nature and limits of the studies. It is the sum of these factors that helps the expedition-bound Curator to answer your same questions for himself.

Let's take this matter of a good set of field notes. I know a competent Curator and field observer who has made five or six summer trips to the West Indies in search of mollusks. His field notes consist, for example, merely of "One mile south of Pirate's Town, Grand Cay. August 1, 1935. *Xancus* and *Oliva* abundant." Profound notes? No, but he was not making a life history study of *Xancus,* nor an ecologic investigation of Grand Cay. He was sampling the marine fauna at 500 stations in the Bahamas. This was later to serve as an important basis for the study of speciation and zoogeography of the Western Atlantic marine mollusks. I also know of a curator who spent three years in the Andaman Islands, Indian Ocean, making observations and experiments on one species of marine gastropod. The result was a splendid and worthwhile report on the biology of *Trochus,* but we know practically nothing about the other marine mollusks of the Andamans to this day. These are two extreme examples of how much information can go into field notes.

Your notes should be geared to fit your circumstances. If you are making short, annual trips to far-off places, make your notes on marine species brief and accurate, and, as time affords, include the following in descending importance; geographical location to within a half-mile; date; general ecological habitat (sandflats, rocks, beach, dredged in 10 feet, etc.); special water conditions (heavy surf, quiet bay, cold or warm water, etc.); relative abundance or scarcity of mollusks, other animals or plants; outstanding habits noticed about certain species (feeding, reproduction, locomotion, etc.); colored paintings of or color notes on certain species; ethnological observations (native uses, methods of collecting, legends). If you are a born collector and hope a *Conus gloria-maris* will turn up at the next reef, you'll be lucky if you have time to write down the first two observations.

On the other hand, if you live a coconut's throw from that Elysian Reef, your notes can follow the above outline, but think of the possibilities! Not just one date, but a year round chronicle of the changing tides, moving sand bars, the seasonal disappearance and reappearance of different species, the breeding and egg-laying periods, the months of increasing size of individuals, the days when predators or storms produce their havoc. And with the help of an aquarium, think how many pages you could write on the color phases, feeding and egg-laying habits and locomotion of your local mollusks! Any curator would be glad to show you a dozen good publications which resulted from such simple observations.

As for some of your specific questions, Mr. Collector, I believe you will find many answers in the booklet entitled "How to Collect Shells" issued by the American Malacological Union in 1955 or in some larger popular books on seashells (modesty prevents me from mentioning one in particular). You should also read an excellent article by Dr. David Nicol, "The Scientific Rôle of the Amateur Malacologist," which appeared in the October 1953 issue of the NAUTILUS (vol. 67, no. 2, pp. 41–44). And as for how many specimens to bring back for the museum, Sir or Madam, you underestimate the greed of a Curator! Seriously, though, most curators would prefer to select out a representative set for their research collections, and return the surplus to you or use them for exchange. Some departments of mollusks

are over-crowded, others specialize only in certain groups, although a few are singularly in position to absorb, exchange or even sell surplus material (modesty again prevents me from mentioning a certain Pennsylvanian institution).

And before I climb the stairs to my ivory tower to continue identifying dusty shells, let me remind you, Mr. and Mrs. Collector, that an amateur is not ''just an amateur'' or novice, but one who loves his work or hobby, whether he be a so-called professional or not, and I would add that it was the widespread interest among many people who created the Curator, and not we few professionals who made your mighty big group.

(signed) A Curator

A NEW BOSTRYX FROM PERU

By H. A. PILSBRY

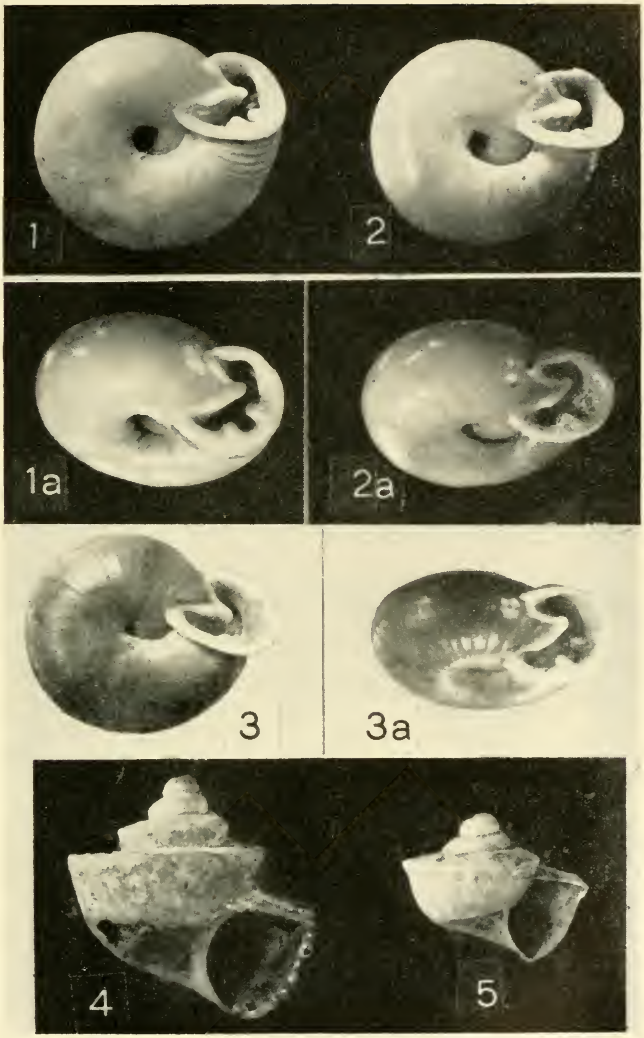
Some years ago a paper on the carinate Bulimulidae of Peru was brought out by A. A. Olsson and the writer. In the examination of Peruvian collections made by the geologist Mr. A. G. Fisher an addition to this peculiar series of land shells came to light. Four specimens of this species were found, all dead and more or less broken, but so distinct from known species that it should be described.

Bostryx (Platybostryx) fisheri, new species. Pl. 5, figs. 4, 5.

The shell is somewhat wider than high, openly umbilicate, the periphery carinate. The first 1½ whorls are smooth, strongly convex, forming a short, obtuse apical nipple. The following whorl is less convex, and the third whorl becomes flattened and carinate, the keel projecting above the suture. The last whorl has a flat, horizontal upper surface and strongly expressed peripheral keel; the somewhat convex lateral outline slopes inward anteriorly, and the base is strongly angular around the ample, funnel-shaped umbilicus. The aperture is subtriangular; peristome simple.

Height 5.6 mm.; diameter 6 mm.; 4⅔ whorls.

Peru: below Tarma on the Tarma-Chanchamayo road. Collected by Mr. A. G. Fisher. Type and three paratypes are 196550 ANSP.



1, 1a, *Polygyra tamaulipasensis* Lea, type. 2, 2a, *Polygyra polita* P. & H., type. 3, 3a, *Polygyra scintilla* P. & H., type. 4, 5, *Bostryx fisheri* Pils., type and immature paratype. All enlarged.

This species appears to be related to *B. erymothauma* of northern Chile, but that is a much larger shell, 12 to 15 mm. in diameter with about the same number of whorls. The spire of *B. fisheri* is much higher than that of the Chilian species and the umbilicus is not so wide. Some specimens show very weak traces of axial wrinkles.

This addition to the small group of carinate *Bostryx* is named in honor of its discoverer.

With these shells there is a fragmentary spire of some other species having a thin keel projecting above the suture, the generic relation unknown.

BEACH DRIFT POLYGYRIDAE FROM SOUTHERN TEXAS

By HENRY A. PILSBRY AND LESLIE HUBRICHT

At the bases of the dunes, near the beaches along the Gulf of Mexico in southern Texas, are to be found incredible numbers of land shells which have been washed in from the sea. Most of these shells are of species which are found living in Texas, but many of them are of Mexican species. The Texas shells appear to be derived from the drainages of the Rio Grande, Brazos, and Colorado Rivers. Not many shells characteristic of the Mexican side of the Rio Grande drainage were found. The El Azucar dam on the lower Rio San Juan and the Don Martin dam on the Rio Salado have apparently prevented many shells from reaching the sea. Most of the Mexican shells appear to be from farther south, from the Rio Pánuco drainage southward.

Shells were collected at the following three places. The abbreviations BC, PIa, and PIb are used, followed by the number of specimens found.

BC. Near the mouth of the Rio Grande, 1 mile south of Boca Chica, Cameron Co., Texas. At this locality, shells were found literally by the millions. Most of the shells were *Polygyra texasiana*. Sorting through the piles of this species became so tedious that not as many foreign shells were found here as at the other localities where *P. texasiana* was not so abundant.

PIa. Padre Island, 2.5 miles north of the Port Isabel Causeway Road, Cameron Co. *T. texasiana* was not as abundant here, numbering in the thousands, but was still numerous enough to hamper collecting of the foreign shells.

PIb. Padre Island, 30 miles north of the Port Isabel Causeway Road, in Willacy Co., Texas. Here the percentage of Mexican shells was higher than at the other localities.

Polygyra cereolus (Mühlfeld), PIb-1.

Polygyra cereolus febigeri (Bland), PIa-3.

Polygyra auriformis (Bland), BC-2, PIa-61, PIb-101.

Polygyra oppilata (Morelet), BC-27, PIa-270, PIb-139.

Polygyra oppilata (Morelet) var. ?, BC-1, PIa-7, PIb-1.

These shells differ from typical *P. oppilata* in having a narrow channel separating the parietal tooth from the end of the upper lip. It may prove to be a distinct species.

Polygyra implicata (Martens), BC-23, PIa-145, PIb-217. This species has been considered a subspecies of *P. oppilata,* but there was no intergradation in the beach drift shells. The two species sorted without difficulty.

Polygyra leporina (Gould), BC-1, PIa-12, PIb-39.

Polygyra rhoadsi Pilsbry, BC-2.

Polygyra ariadnae (Pfr.), BC-1.

Polygyra texasiana (Moricand). The material found on the beaches shows all the variation in size and sculpture found in the species. In sculpture the shells vary from smooth to rib-striate above and below. Smooth shells are found living along the western edge of the range of the species, being found from the Pecos River eastward to Roma, Starr Co., Texas, and Oglesby, Coryell County. In Mexico it is found at Cerralvo, Nuevo Leon. Shells with basal rib-striae are found only within a few miles of the coast, in Cameron, Willacy, Calhoun, and Harris Counties, Texas.

Three sinistral specimens were found at Boca Chica.

Polygyra texasensis Pilsbry, BC-10, PIa-33, PIb-2.

POLYGYRA SCINTILLA, new species, pl. 5, figs. 3, 3a. BC-15, PIa-38, PIb-4.

The shell is strongly depressed, with rounded periphery, the spire very low or nearly flat. The surface is almost smooth, being finely striate above and below, with a few rib-striae behind

the lip. Color pale brown, usually with a narrow reddish-brown band above the periphery. The umbilicus has an externally small axial hole, expanding in the last half whorl to about one-seventh of the diameter of the shell. The last quarter whorl is strongly expanded, giving the shell an oval outline. The last whorl descends abruptly in front, and is deeply contracted behind the lip. The lip is reflected, forming about three-fourths of a circle, rather heavily callused within, strongly dished, with two rather slender teeth, set close together, one basal, the other on the outer margin. Parietal tooth v-shaped, lower branch straight or nearly so, upper branch with a slight curve. There is no internal tubercle on the columellar wall.

Height 3.6 mm.	Diameter 7.5 mm.	4.3 whorls.	Paratype.
Height 4.8 mm.	Diameter 10.0 mm.	5.0 whorls.	Paratype.
Height 4.2 mm.	Diameter 9.1 mm.	4.7 whorls.	Holotype.

TEXAS: Willacy Co.: along the railroad, 1.5 miles north of Raymondville. Holotype 196560 and Paratypes 196559 ANSP Paratypes 14407, collection of L. Hubricht. MEXICO: Nuevo Leon: drift, Rio Sabinas, Sabinas Hidalgo. Tamaulipas: loess, 1.4 miles southeast of Cuidad Mier; drift, Rio San Fernando, San Fernando; roadside, 9 miles southwest of Santa Teresa.

This species differs from *Polygyra texasiana* (Moricand) by its more depressed, more oval shell, and the smaller central hole of the umbilicus. The lip is more dished, the ends of the lip come closer together, and the teeth are more slender. The lower branch of the parietal tooth is straighter. The umbilical region resembles that of *P. jacksoni* (Bland).

For comparison we figure (pl. 5, figs. 2, 2a) *Polygyra polita* Pilsbry and Hinckley, 1907, described from Tampico, in river debris (Nautilus **21**: 38, pl. 5, f. 11). This has a wider axial hole of the umbilicus than *P. scintilla* and the peristome is more "dished."

Polygyra texasiana tamaulipasensis Lea (pl. 5, figs. 1, 1a) as another related species, of which we figure the holotype, 117885 USNM., by courtesy of Dr. Rehder. It has a nearly flat spire of 4½ whorls, with a diameter of 9.6 mm. The surface is nearly smooth except behind the upper and outer lip where there are five or six riblets. The umbilicus is contained about 4.8 times in the diameter. Its axial hole is larger than in *P. polita*, therefore much wider than in *P. scintilla;* and it differs from both in having the tooth of the outer lip on the same level

as the basal tooth. In *polita* and *scintilla* the outer tooth is more deeply placed, only partly visible in a direct basal view.

P. t. tamaulipasensis seems to be completely identical with the form described as *P. t. hyperolia* Pilsbry & Ferriss (Proc. A.N.S. Phila. 1906, p. 128, pl. 5, figs. 13–15) from the high mesa west of Devils River, Val Verde Co., Texas. Lea's type looks like a river drift specimen, having their characteristic polish.

Polygyra mooreana (W. G. Binney), PIa-83, PIb-192.

Polygyra tholus (W. G. Binney), BC-2, PIa-69, PIb-217. The shells of this species sorted from those of *P. mooreana* without difficulty.

Polygyra dorfeuilliana Lea, PIa-45, PIb-96.

Polygyra dorfeuilliana sampsoni Wetherby, PIa-1. For this specimen to have come from the known range of *sampsoni* in northwestern Arkansas or northeastern Oklahoma it would have had to drift down some Arkansas river into the Mississippi, thence into and across the Gulf of Mexico, which seems an impossible journey. It is more probable that it is an aberrant shell from somewhere in Texas.

Stenotrema leai aliciae (Pilsbry), BC-15, PIa-147, PIb-359.

Praticolella griseola (Pfr.), BC-2, PIa-2.

Praticolella berlandieriana (Moricand), BC-9, PIa-1.

Praticolella pachyloma ('Menke' Pfr.), PIa-1.

FRESH-WATER MOLLUSKS AND STREAM POLLUTION

By CHARLES B. WURTZ

Consulting Biologists, Philadelphia 2, Pa.

The intense interest throughout the nation today on pollution, clean-stream programs and conservation, has led to an intensification of study into the biological effects of pollution.

Pollution is commonly divided into three basic types. These are physical, such as siltation or high temperatures; chemical, such as acidity or toxic wastes; and biological or organic. The latter consists of organic waste material that is not in itself

toxic, but which may, by its decomposition in nature, exert an oxygen demand in excess of that found in natural waters. Both sewage and many industrial wastes contribute to this type of pollution. Since the effect of both physical and chemical pollution upon the fauna of a body of water is usually direct, and usually absolute, these types of pollution are not further considered here.

Organic pollution passes through various degrees of intensity. When an organic pollutant first enters a body of water it may have no immediate effect upon the water. As time passes this material is broken down by bacterial action. The bacteria concerned demand oxygen for their life processes, although some phases of decomposition may be effected by anaerobic bacteria. If the volume of organic material is slight in comparison to the volume of water in the receiving body, the pollutant may, in effect, be nothing but an enrichment of the water. Actually, this is fertilization of the water. Because of this, a slight organic pollution may be a desirable feature in a stream or lake. However, when the volume of organic waste flowing into a body of water is so large that the bacteria that contribute to the decomposition of the material exhaust the available oxygen in the water, septic conditions occur. This is putrefaction and is gross pollution. All intermediate conditions occur.

In flowing water, which is the usual depository for effluents disposing of waste materials, a septic condition usually does not occur until the material has passed some distance downstream. The actual distance is quite variable and depends on temperature, rate of flow, volume of organic matter in relation to water volume, and many other factors.

When large volumes of organic waste are dumped into a stream, the stream first enters a zone of degradation. As the pollutant proceeds downstream, and the bacterial content increases, a septic zone develops where there is no oxygen. Below the septic zone, and associated with the completed decomposition of the organic waste, a recovery zone is found. Below the recovery zone the stream returns to a clean-stream condition. If the pollution load is not too great there may not be a septic zone; the zone of degradation gives way to the recovery zone. In most streams in the highly industrialized east one waste

effluent succeeds another in the course of the stream from its headwaters to its mouth. As a result, the stream may not have a clean-water zone anywhere throughout its whole course, although septic pollution may not be present.

In the study of stream biology in relation to pollution, it was early recognized that some species of organisms could withstand pollution in varying degrees of intensity, while others were eliminated from the fauna if only a small amount of pollution was present. As these latter species disappeared, reducing the number of species in any particular habitat, the more tolerant species increased in number to take advantage of the available food or fill the available space. If predator species are eliminated by pollution (and many are) there is no way to hold the more tolerant species in check, and large populations of these species occur. A typical example of this is the very tolerant worms of the family Tubificidae. Some species of this family are so tolerant that they develop vast populations below sewage outlets where other animals cannot live. This phenomenon has resulted in their common name, ''sewage worms.''

During the course of my own work in this field, I have culled the literature on the subject, and gathered together all the available information on the response of North American fresh-water mollusks to pollution. This includes only those mollusks identified to the species level. General statements concerning families or genera are not helpful when interpreting stream conditions based on specimens actually collected at a given spot. Some observations are based on my own field work, while others were originally made known by other workers.

In presenting the following list of species known to be tolerant it must be borne in mind that we are woefully lacking in knowledge on this subject. We do not yet know the exact tolerance limits of any of these species, although, so far as I have been able to ascertain, no mollusks are able to withstand protracted gross pollution. We can anticipate that many species will be added to the list as further work continues. The species listed below can survive, at least to some degree, in the zones of degradation and recovery.

Pelecypoda

Mytilopsis leucophaeatus (Conr.)
Rangia cuneata Gray
Sphaerium rhomboideum (Say)
Sphaerium corneum (L.) [1]
Sphaerium striatinum (Lam.) [2]
Sphaerium sulcatum (Lam.)
Sphaerium (Musculium) securis Prime
Sphaerium (Musculium) transversum (Say)
Pisidium amnicum (Müll.) [3]
Pisidium casertanum (Poli)
Pisidium compressum Prime
Pisidium fallax Sterki
Pisidium henslowanum (Sheppard)
Pisidium subtruncatum Malm.

Gastropoda

Campeloma integrum (Say)
Campeloma rufum (Hald.)
Bulimus tentaculatus (L.) [4]
Lymnaea caperata Say
Lymnaea humilis Say
Lymnaea obrussa Say
Lymnaea palustris (Müll.)
Lymnaea stagnalis (L.)
Lymnaea auricularia (L.) [3]
Pseudosuccinea columella (Say)
Helisoma anceps (Menke)
Helisoma trivolvis (Say)
Gyraulus arcticus (Müll.)
Menetus dilatatus (Gould)
Aplexa hypnorum (L.)
Physa gyrina Say
Physa heterostropha (Say)
Physa integra Hald.
Ferrissia fusca (C. B. Adams)
Ferrissia tarda (Say)

Physa heterostropha is the most tolerant species that has been found. As it is common and widespread it would be expected to occur repeatedly in collections. It is tolerant to the extent that some workers have considered it as an ''indicator species'' for pollution. Members of this genus have been known to clog trickling filters in waste disposal systems, but to date I have had no opportunity to examine any material of this type so cannot venture an opinion on the species concerned.

No Unionidae have been found to be tolerant to polluted conditions. We can conclude that this family is more sensitive to

[1] Found throughout the Great Lakes region and may represent a European introduction.

[2] This has been recorded from a pollution zone as *S. notatum* Sterki.

[3] Recently introduced into the Great Lakes region.

[4] Introduced into the Great Lakes region where it is now very common.

pollution than the Sphaeriidae. Unionidae are found in the Pennypack Creek in Philadelphia, and this stream was just this year (1955) closed to public bathing because of "pollution." However, this closure was based on public health standards and is contingent on the coliform bacteria count. It does not imply a heavy pollutional load, but, rather, reflects water quality. The coliform bacteria are an indication of pollution from sewage, and a very little of this goes a long way when it comes to recreational waters.

OBSERVATIONS ON THE RECENTLY EXTINCT MOLLUSK FAUNA OF PANAMINT LAKE

By JOSHUA L. BAILY, JR.

The opportunity to examine an interesting collection of semi-fossil shells from the dry bed of Panamint Lake in Inyo County, California, has recently been given this writer by Dr. Carl L. Hubbs of the Scripps Institution of Oceanography at La Jolla, California. This opportunity was especially welcome because it makes possible the comparison of the mollusk fauna of this area with that of the pleistocene Lakes Lahontan and Bonneville, upon which the present writer has recently reported (Nautilus, vol. 63, pp. 73 et seq.).

The physiography of the Panamint area is now the object of Dr. Hubbs' researches, and he is now preparing a report upon it. The mollusks taken by Dr. Hubbs are as follows:

VALVATA HUMERALIS CALIFORNIA Pilsbry

The type locality of this species is in Mexico, but the variety is found as far north as Puget Sound. It has a less elevated spire than the typical form. Specimens from Panamint Lake are intermediate between the type and the variety, just as has already been found to be the case in Utah Lake and Bear Lake.

AMNICOLA LONGINQUA Gould

The *Amnicola* from Panamint Lake is certainly not *Amnicola integra* Say, the species characteristic of Lake Lahontan, nor is it *Amnicola limosa* Say, which characterizes Lake Bonneville.

It seems more prudent at present to identify it with *Amnicola longinqua* Gould, a well-known species from Lake LeConte in the Colorado Desert, which has also been reported from Utah. It resembles *Amnicola pilsbryana* Baily (loc. cit., p. 50, pl. 4, f. 3, as *A. Pilsbryi*, preoc.) but is about twice the linear dimensions of that species. Further, the latter is known only from Bear Lake in Utah and Idaho, and this writer naturally hesitates to identify as conspecific two populations from two localities so remote from each other, when no similar form is found in the intervening territory.

Lymnaea kingii utahensis Call

This form was originally described as a distinct species (Bull. U.S. Geol. Surv. no. 11, p. 47, 1884) but some modern authorities believe it to be indistinguishable from the Pliocene *Lymnaea kingii* Meek (U. S. Geol. Surv. Terr., vol. IX, p. 532, 1876) of which it is undoubtedly a lineal descendant. F. C. Baker (The Lymnaeidae of North and Middle America, pl. XVII, f. 1, 2, and pl. XXIV, f. 22–7, 1945) has illustrated both nominal species. The columella, which in *L. kingii* is plaited and oblique, and in *L. k. utahensis* simple and vertical, seems to afford a basis for its recognition as a subspecies, for which reason Call's name is retained here with that rank. Baker's statement (loc. cit., p. 103) that Call's figures are not good and do not correctly represent the species is not borne out by his reproduction of them (loc. cit., pl. XXII, f. 9–11); actually they are very good representations of an extreme form sometimes assumed by this very variable subspecies.

Parapholyx effusa costata Hemphill.

Baker (The Molluscan Family Planorbidae, p. 164, 1945) recognized as valid five species of the genus *Parapholyx* together with four varieties which he considers entitled to the rank of subspecies. While it is quite possible that several different species may be involved, variation in this genus is so great that examination of a large series of individuals seems to eradicate many of the supposed differences, just as the present writer had already found the situation in the case of this genus from Pyramid and Humboldt Lakes (loc. cit., p. 86).

On the Panamint Lake material the predominating form seems to be characterized by two sets of costae intersecting each other at right angles, either one of which may be absent, for which reason this writer is inclined to identify this material as *P. e. costata* Hemphill, but it must be borne in mind that specimens entirely devoid of costae occur in this population, and these are connected with the costate forms by intergrades, so that their separation is not practical. In fact, Baker (loc. cit., pl. 116, f. 12–4) figures completely smooth examples under this name.

Haldane (Science Advances, pp. 85–95; 213–4; 227–32, 1948) has expressed the belief that a race must not be conceived of as a separate variant but as a mixed population of several variants distinguished by the proportions in the population constituted by each variant. If this definition of race be accepted then it becomes clear that the Panamint population is not a subspecies though it may be a race. On the whole, the shell of the Panamint race tends to be heavier and more costate than that of the Lahontan race, although it would be easy to select individuals of any pattern from the two populations that would be quite indistinguishable from each other.

Carinifex newberryi Lea

Baker (loc. cit., p. 158) lists four species and three additional subspecies of this genus. Although the Panamint material is highly variable no one need hesitate to assign all of it to this species.

In addition to the five species mentioned above there is one species each of *Physa, Anodonta,* and *Pisidium.* Any guess as to the specific identity of these is hardly justified by the present state of our knowledge.

The *Anodonta* is represented by a single fragmentary cast, the *Pisidia* are all single valves and too young, and the nomenclatorially chaotic state of the genus *Physa* is such as to make it extremely hazardous for any one to ''stick out his neck'' in an effort to append a name to these specimens that will not meet with disapproval from some quarter.

There are two peculiar features of the Panamint Lake fauna. First is the complete absence of the genera *Gyraulus* and

Helisoma. These are represented practically everywhere in North America. Both contain widespread species and species of limited distribution, sometimes several species of each are found together in the same body of water, and in number of individuals they usually surpass those of other species living with them.

Second is the occurrence so far south of the genera *Carinifex* and *Parapholyx* and the subspecies *Lymnaea kingii utahensis.* The first of these has two species of highly localized distribution, one in Klamath Lake, Oregon, and the other in Jackson's Hole, Wyoming. These are readily recognizable. The third species, *Carinifex newberryi,* is very variable and its habitat extends from Clear Lake in California to Bear Lake in Utah and Idaho. The present writer cannot recognize more than one species of *Parapholyx,* whose distribution is almost as wide as that of *Carinifex.* Baker (The Lymnaidae of North and Middle America, p. 460) restricts the habitat of *Lymnaea kingii utahensis* to Utah. Panamint Lake is so far outside the limits of the recorded ranges of these three species as to be quite a surprise.

Baker (The Molluscan Family Planorbidae, p. 164) lists *Parapholyx leana* H. and A. Adams from West Columbia, which locality he identifies as British Columbia, and doubts that this practically unknown species could have been taken north of the United States. The present writer would suggest that West Columbia in the original description may be a typographical error for West Colombia, a name formerly applied to what is now called Ecuador. This country is far outside the range of *Parapholyx,* but the next nation to the south, Peru, is the home of the genus *Taphius,* which while not closely related anatomically to *Parapholyx* bears a striking conchological resemblance to it. Since the older of the two Adams brothers worked extensively with South American land snails, it seems reasonable to suppose that "*Pompholyx*" *leana* may have been a *Taphius* from Ecuador.

In conclusion the writer wishes to thank Dr. Hubbs for the privilege of examining this collection.

STATISTICS ON A COLONY OF CEPAEA NEMORALIS

By M. ALAN LANDMAN

In his paper, "The Variation of Banding in Cepaea," Dr. F. A. Schilder of the University of Halle, Germany, wrote in the NAUTILUS (62: 4): ". . . statistical studies need further research; it could be supported by American malacologists publishing similar exact data on the *Cepaea* observed in restricted localities. . . ." Recently I compiled some data concerning a colony of *Cepaea nemoralis* which I hope will further these studies.

On Thursday, September 23, 1955, I discovered the colony on a section of a city block in Springfield Gardens, Queens, New York City. The block is about 145 meters by 60 meters in area and is bounded by Merrick Blvd., Sunbury Rd., Irwin Place and Ursina Rd. in Springfield Gardens. About one-quarter of the block at Irwin Pl. and Ursina Rd. has dwellings, but the lot area takes up about 6300 square meters. At least four-fifths of the specimens collected were taken in the quadrant at Irwin Pl. and Sunbury Rd. and, in fact, very little else on the block was explored. Thus, I would estimate that the colony consists of about 5000 individuals on that block.

The surface of the lot has many depressions and much debris is scattered about, providing good cover for snails. The debris consists of corrugated board boxes and wooden boards and slats, with a couple of rejected seat cushions also yielding a good quantity of snails. The lot is overgrown with the usual common weeds, such as crabgrass (*Digitaria* sp.), dandelion (*Taraxacum officinale*) and dock (*Rumex*). The trees include oak, maple and wild cherry. Ragweed (*Ambrosia*), milkweed (*Asclepias*) and poison ivy (*Toxicodendron*) also have a foothold. Numerous Diptera were present, there being some garbage material on Irwin Pl. One *Limax maximus* was found and several dozen Blattidae were seen scurrying around and under some of the cardboard pieces lying around. Two DeKay snakes were also seen under wooden slats.

In four trips to the colony I collected 1297 individuals and indexed them according to bands. A majority of the snails have

a yellow ground color (variety *libelulla*), but a few red snails (var. *rubella*) were also present. The variations are as follows:

yellow ground color

669	00000	3	(12)0(45)	1	12340
333	12345	3	10345	1	10000
43	00300	2	(12)045	1	(12)(34)5
44	123(45)	2	(123)45	1	023(45)
28	12045	2	1(23)45	1	00340
12	(12)3(45)	2	12305	1	10045
6	02345	2	(12345)	*red ground color*	
6	(123)(45)	1	120(45)	104	00000
5	(12)345	1	12(34)5	4	12345
5	(23)(45)	1	(12)(345)	13	00300

In practically all specimens the shells were in prime condition, only a few showing signs of erosion of the nuclear whorls. It was noticed, though, that the best preserved shells were taken from the ragweed on Irwin Place and from the clumps of iris lining the side of the dwellings, the rest of the lot ground being comparatively open.

While I was collecting, I talked to a number of people nearby. One man said that he had noticed the snails for more than forty years. This seems to agree with the large number of specimens found and seen in such a relatively small area. To a degree it also coincides chronologically with reports of a Flushing colony in 1906. The present colony is located not far from Flushing, and its origin may well be in specimens from the latter area.

Along with the main colony at Merrick Blvd. and Sunbury Rd. in which I spent four hours, I also explored some secondary lots and discovered more *nemoralis*. About two blocks from the main lot is a smaller one at the corner of Sunbury Rd. and 120 St. This block, incidentally, is in St. Albans. I spent two hours there and indexed 92 snails. The totals:

yellow				*red*	
50	00000	2	(12)3(45)	6	00000
25	12345	1	10345		
7	00300	1	12045		

The results seem to show this group as some sort of offshoot of the large lot. Among the plants seen were bouncing-bet (*Saponaria officinalis*), Japanese honey-suckle (*Lonicera japonica*), *Ambrosia, Quercus, Acer, Prunus, Aster,* snapdragon (*Antirrhinum*), golden rod (*Solidago* sp.), milkweed (*Asclepias* sp.) and sassafras (*Sassafras variifolium*). *Limax maximus* were present and I also took a specimen of the beautiful *Coptocycla* (or *Metriona*) *bicolor.*

On Sunday, September 26 I collected again. It was right after a rain and the ground was in good snailing condition. Five blocks down Merrick Blvd, from Sunbury Road past the St. Albans Naval Hospital is a park at the northwest corner of Linden and Merrick Blvds. At its outskirts, behind large billboards, is a very nice lot section. Browsing through it, I turned up five interesting specimens. There were single specimens of (all yellow): 00300; 123(45); (12)3(45); (123)(45) and 00345. This seems unusual, since the other lots were completely dominated by 00000 and 12345. There are many speculations possible with regard to this but only five individuals were found and there doesn't seem much basis for a definite statement.

Finally, across the street at Sunbury Rd. on the same side of Merrick Blvd. is another lot. It is also bounded by Baisley Blvd. A quick look through it brought out eight snails which followed the common percentages well. Included were:

	Yellow		*red*
3	00000	1	00000
2	12345		
1	123(45)		
1	(12)3(45)		

I have a number of plans concerning the snails reported on here and intend to use them for a breeding project. I hope in a later issue of the NAUTILUS to report on my experiment and observations.

I wish to acknowledge the kind advice and assistance of Dr. William J. Clench of the Museum of Comparative Zoölogy, Dr. R. Tucker Abbott of the Pilsbry Chair of Malacology at The Academy of Natural Sciences of Philadelphia, and Mr. Morris K. Jacobson.

PUBLICATIONS RECEIVED

Bivalvia. By F. Haas. Bronns Klassen und Ordnungen des Tierreichs, ''Band'' 3, class 3, part (real vol.) 2, no. 4, pp. 679–909, i-xii, 2 textfigs. 1955.—After a necessary wait of 14 years, this issue, to be followed by bibliographic supplement, concludes the text of the two volumes on pelecypods. In completion of the general subject of ecology, it discusses environmental relations (mainly in no. 3), the American oyster, the edible mussel, and gill function, nourishment, excretion, chemical make-up, blood, growth and age, reactions, intelligence and diseases of the class. It also includes references to the autecologic (and physiologic) authors, supplementary lists for vols. 1 and 2, and a fine index for vol. 2. Title pages, preface and table of contents are appended. The text is semantically clear and pleasant to read, since it does not hesitate to use relatively terse (and international) terms. Dr. Haas must be indeed proud of these indispensable reference books, which bring up to date the accumulated knowledge about bivalves, and point the way for future studies.

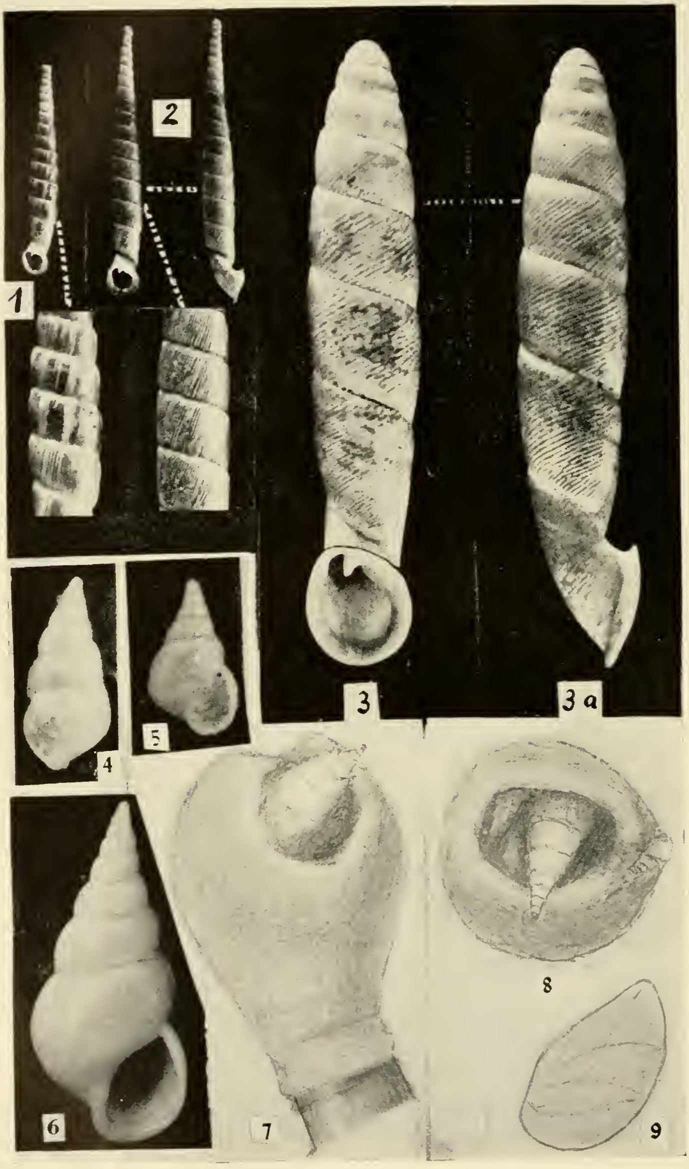
One apologizes for any criticism of so much masterly achievement. The great ability of most mollusks, in the reversible transfer of Ca-salts between body fluids and shell, is discussed (pp. 743–5 and 810–2) but the treatment of its ecologic significance seems inadequate. For example, is not the solution from the shell of $CaCO_3$, since it buffers the tendency towards pH reduction (increase of CO_2) in the blood during aestivation (when shells are closed or sealed), fundamentally important in the animals' resistance to dryness (pp. 698–701)? —H. B. B.

Ulpia, nuevo genero de Gastropoda terrestre. Par M. I. Hylton Scott (Neotropica 1, No. 5, pp. 65–68, figs. 1–4). The genus *Ulpia* is proposed for a minute, conical, openly umbilicate land shell having apertural teeth similar to *Gastrocopta,* as the author remarks. It was found by Dr. Max Biraben at Lumbrera, province of Salta, Argentina. It is placed provisionally in the Odontostominae, but we think that it belongs to the Pupillidae, subfamily Gastrocoptinae, near the little-known *Gibbulina infundibuliformis* (Orbigny); but it differs from that species by the more lateral aperture and the presence of five teeth.—Pilsbry.

American Seashells, third printing.—In the third printing of *American Seashells* (D. Van Nostrand Co., N. Y., May 1955), approximately 200 text changes were made, most of which were typographical adjustments, although some names were changed, ranges corrected, and additional bibliographic references added. The author wishes to thank the many people who kindly pointed out needed improvements. Some corrections were not included by the publisher: p. 119, *Tegula hotessierana* Orbigny should be considered a young and threaded form of *Tegula fasciata* Born; p. 123 (and pl. 3k, m) for *Astraea longispina* Lamarck, read *A. phoebia* Röding; p. 198, *Bursa granularis* Röding, upon examination of the radula and anatomy, proves to be a distinct Indo-Pacific species, so that we must return to the name *cubaniana* Orbigny for our West Indian species (see also pl. 25–0); p. 363, *Pecten tereinus* Dall is evidently a synonym of *chazaliei* Dautzenberg (see G. Grau, Nautilus, vol. 68, p. 113).—R. Tucker Abbott.

Critical review of biology and control of oyster drills, *Urosalpinx* and *Eupleura*. By M. R. Carriker. Special Scientific Report, Fisheries no. 148, U. S. Fish and Wildlife Service. 150 pp., 15 tables. 1955.—This is a very careful, complete and much-needed review of the great amount of research that has been done on the biology and control of *U. cinerea* Say and *E. caudata* of our Atlantic coast. Many interesting summaries are given concerning the geographical distribution, morphology, life history, relation to environmental factors, and control of these two species. The bibliography contains 177 useful references, most of which deal directly with these oyster drills.—R. T. A.

New marine mollusks from Florida. By Thomas L. McGinty. Proc. Acad. Nat. Sci. Phila., vol. 107, pp. 75–85, 2 pls. Nov. 1955.—Twelve new species of deep-water marine mollusks are described in this article. Included is a remarkable new genus and species (*Aclistothyra atlantica*) of a Galeommid bivalve resembling the *Ephippodonta* of the Indo-Pacific. A new Fasciolariid genus, *Fusilatirus,* is erected for *pauli,* new species and type, and *cayohuesonicus* Sowerby, on the basis of the very unusual lateral radular teeth. The shells, however, are extremely close to those in the genus *Dolicholatirus* Bellardi 1884, and the recent species of the latter could bear investigation.—R. T. A.



1, *Gracilinenia filicostulata* Lubomirski. 2, *G. aequistriata* Weyrauch, type. 3, *Nenia* (*Columbinia*) *zischkai* Weyrauch, type. 4, 5, 6, *Mucronalia nidorum* Pilsbry, shells. 7, 8, nests in sea urchin spines. 9, operculum.

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A GASTROPOD DOMICILIARY IN SEA URCHIN SPINES

By HENRY A. PILSBRY

Some years ago, in the ''Triton'' dredgings off Palm Beach, Florida, Thomas and Paul McGinty found that the sea urchin *Eucidaris tribuloides* (Lamarck) was occasionally found to have a very short and swollen spine or two among those of the normal cylindric shape. On examination, these were seen to be spines modified to form cup-like ''nests'' of small white gastropods. One of these ''nests'' is drawn in Plate 6, figs. 7 and 8.

One of the sea urchins was kept alive for several days. The modified spines could be moved about slowly, like the others. The enlargement forming the nest begins above the smooth dark red band around the spine next to the joint, and is oval in shape, as in the drawings. It is often concealed by the body scales of the urchin. It is nearly rigid, though not quite as hard as the normal spines, and of about the same dull red color. The nest drawn is about 5.5 mm. long, 4.5 mm. in diameter. It had one large and three smaller inmates. Some other nests contained single snails.

The snails were retracted and quiet by day, but evidently active at night. Several were seen abroad early in the morning, one on a spine more than an inch from the nest, to which it returned later. However, I never saw one in motion, though I spent a good deal of time watching them.

The earliest reference I have found to a similar use of sea urchin spines is as far back as 1860: Hupé, in Magazin de Zoologie (2 ser.) 12: 118–125. He described a *Stylifer orbignyanus* from ''Nouvelle Hollande.'' This Australian species has a very short spire and large last whorl and seems properly referred to *Stylifer,* but it apparently lives in much the same way as our Floridan species.

So far as I know, this interesting snail has not been noticed before. A description of the shell follows. The generic refference is not certain.

MUCRONALIA NIDORUM, new species. Plate 6, figs. 4, 5, 6.

The rather thin white shell is imperforate, lanceolate, smooth and glossy. The upper part (about a fourth of the length) is somewhat attenuate and slightly curved. The minute apex is erect with rounded tip. Several following whorls are only weakly convex, with superficial suture. The aperture is contained about 2⅔ times in the length; the peristome with regularly semicircular outer and basal margin; the inner margin concave. Columella thickened.

The operculum is very thin, long ovate, showing some faint lines indicating former stages of growth; the nucleus is apparently near the base on the columellar margin, but not distinctly indicated (Pl. 6, fig. 9).

No radula could be found.

Length 3.7 mm., diameter 1.7 mm.; 9½ whorls.

The type and figured paratypes are no. 196745 ANSP., from "Triton" (A. R. Thompson's yacht) station 821, off Palm Beach, Florida, in 25 fms. Other paratypes in McGinty collection.

The amount of curvature of the upper part of spire apparent depends of course upon the position of the shell, but there seems to be a little individual variation in this feature, curvature being scarcely noticeable in some examples, more distinct in others.

The author is deeply indebted to the McGinty brothers for opportunity to examine this interesting mollusk, and to Axel A. Olsson for excellent photographs (Figs. 4–6) of difficult subjects. Thanks are also offered to Miss Elizabeth Deichmann of the M. C. Z. for identification of the sea urchin.

TWO NEW SPECIES OF CLAUSILIIDAE FROM PERU AND BOLIVIA

By DR. WOLFGANG WEYRAUCH

Professor of Zoology, University of San Marcos, Lima, Peru.

GRACILINENIA AEQUISTRIATA, new species. Plate 6, fig. 2.

Diagnosis: A species of the genus *Gracilinenia,* characterized by its considerable length, equally spaced striation and flattened whorls.

Description of type: The shell is entire, very thin, extremely slenderly fusiform-turrited. Color uniform light, somewhat reddish brown, whitish frosted by the sculpture of the surface. The apex globular. Second embryonic whorl decidedly convex, wider than the first and 3d whorl. Third to seventh whorls slowly diminishing in convexity; later whorls very slightly convex, nearly flat. From the 3d to the largest, third from last whorl steadily and slowly increasing in width. The last whorl with straight lateral outlines, flattened on the upper half of the back, strongly descending and widely built forward to the aperture. The surface matt, with sculpture of thin lamella-like raised riblets, mostly whitish, in places light brown, slightly oblique, continuous and very shortly curved to the right at the upper end, where they are falling into the furrow of the deeply impressed suture. The riblets are regularly spaced, on the face of the last and penult whorl 8 in 1 mm., on the earlier whorls slightly more spaced, on the face of the seventh whorl 5 to 6 in 1 mm. The aperture is funnel-shaped, slightly longer than wide, evenly rounded, except for the left side, which is somewhat straightened. The peristome is broadly expanded, slightly thickened. The upper margin of the peristome is white, like the adjacent part of the aperture; its outer and basal margins are yellowish brown, like the adjacent interior of the aperture. The superior lamella is white, high, emerging to the lip edge, not surpassing the plane of aperture, rather thick, slightly oblique towards the concave left side; it slowly diminishes within and is continuous with the spiral lamella. The inferior lamella is white, very low, but shortly visible in front view of the aperture; its lower end rapidly converging towards the superior lamella; its upper half parallel and very close to the spiral lamella. The subcolumellar lamella is largely visible in oblique view in the aperture and is widely separated from the lower end of the lunella. The principal plica is low, white on the upper rim, light brown on the sides, parallel to the suture, half a whorl long and surpassing slightly the upper end of the lunella. The lunella is developed merely as a very low, whitish, callous ridge, short, slightly and evenly curved. The clausilium occupies the whole space between lunella and subcolumellaris, is wide at the middle of the spatula, and its end pointed.

Notes on paratypes: 24 specimens with the same data as the type. All characters rather constant, except the following: 13 specimens decollate and 11 entire. Color varying from light reddish to yellowish brown. In the latter specimens the interior of the aperture is very light brown and the peristome entirely white. The lunella is shortly or widely separated from the subcolumellaris or continuous with that. Accordingly the

end of the clausilium is more or less pointed or more or less broadly rounded. The following measurements are in mm.

Alt.	Diam.	Alt. apert.	Lat. apert.	Whorls	
30,4	3,5	3,8	3,6	18	entire, Type
30,5	3,5	3,9	3,8	16½	entire
29,7	4,0	3,7	3,5	17¼	entire
29,6	3,8	3,6	3,4	17½	entire
26,8	3,8	4,3	3,6	11¼	decollate
24,2	3,6	4,0	3,7	11½	decollate
22,3	3,2	3,8	3,2	9½	decollate
21,7	3,5	3,6	3,5	9½	decollate

Type locality: Peru: Valle de Chanchamayo, on the highway from Hacienda Naranjal near the village San Ramón to the mine ''Pichita-Caluga''; elevation not measured, but probably at about 1300 m. Collected by the author.

Material: Type WW 1531 and 11 paratypes in the author's collection; 2 paratypes in the Senckenberg Museum, Frankfurt a.M.; 2 paratypes in the Academy of Natural Sciences of Philadelphia; 2 paratypes in the Museum of Comparative Zoology, Cambridge, Mass.; 2 paratypes in the Chicago Natural History Museum; 3 paratypes in the collection of Dr. F. E. Loosjes, Wageningen, Netherlands; 2 paratypes in the collection of Prof. Dr. W. Blume, Göttingen.

Comparisons: Closely related to *Gracilinenia filicostulata* Lubomirski, which is figured for comparison (Plate 6, fig. 1), but mainly different by equal spaced striation and strikingly flattened whorls. Secondary differences: shell higher, somewhat wider, several whorls more, color darker, more solid, either decollate or entire in completely adult specimens, whereas *filicostulata* is always decollate in adult state.

Ecology: The 25 specimens were collected in 5 minutes on the bare face of an isolated limestone block, about 2 m. high and 3 m. wide, in a clearing of the tumid and high arboreal vegetation of the subtropical rainforest. The block was protected against direct sunlight by some high brushes and young large-leaved trees of *Ochroma* spec. Strewn around the big block were smaller limestones of varying sizes, on which no specimen could be detected. The black animals were met on a cloudy, though not rainy day, at 3 p.m. crawling upward on the vertical planes of the rock, which were covered with a sheet of green, unicellular *Chlorella*-like algae. The shells were partly covered with the same algae. The excrements, deposited by the animals, were of uniform light

green color in all specimens. A microscopical study revealed merely the destroyed remains of algae and no trace of fibers of higher plants. 16 specimens of *Peruinia peruana slosarskii* (Lubomirski) were found crawling around on the same limestone block, not only on its vertical surfaces, but also on top of the rock, covered with a thick layer of rotting leaves.

Nenia (columbinia) zischkai, **new species.** Plate 6, figures 3, 3a.

Diagnosis: A species of the subgenus *Columbinia,* characterized by its considerable size, almost cylindric shape and sculpture of strong, evenly spaced and strongly slanting riblets.

Description of type: The shell is entire, sinistral, rather solid, elongate cylindric-fusiform, widest at the two penult whorls. The color is uniform cinnamon-brown, except for a very thin, whitish band below the suture. Apparently collected shortly after death, and therefore with a thin layer of a brownish white, calcareous overwash, filling partly the interspaces of the riblets and the interior of aperture. The apex obtuse and very large. First three postembryonal whorls very weakly convex; later whorls nearly flat; the last whorl much elongated, becoming free and produced to the aperture. Suture moderately impressed, very regularly obtusely denticulate by the riblets, which are somewhat thickened and projecting at the upper end. Surface matt, and after 2 embryonic whorls, whose sculpture is corroded by weathering; it has a rough sculpture of strong, low, rounded riblets, continuous between the suture, somewhat narrower than their intervals, strongly oblique, more so on the last three whorls, where they form an angle of 45 degrees with the suture. There are 3 riblets in 1 mm. on the two penult whorls and 42 riblets crossing the periphery of the penult whorl. On the last whorl, the riblets become lower, more crowded; behind the peristome they are still narrower, more wavy and frequently interrupted. The principal plica and lunella are marked in their whole course on the outside of the last whorl by a deep and very thin incision, just as though cut with the point of a sharp knife and interrupting the riblets. Aperture completely free, evenly rounded, broadly ovate, somewhat pear-shaped. Plane of aperture somewhat oblique, convex in profile and evenly concave in the direction of the shell axis. Interior of aperture light rose-brown, fading to a dirty ivory-white on the upper and right side of the peristome, whose left and inferior half is colored like the interior of the aperture. Peristome thickened, strongly expanded throughout and well reflected. Superior lamella not protruding above the peristome, thick, highly raised, emerging to the lip edge, earlike, very

deeply concave on the left side, continuous with the lower spiral lamella, forming with this a slightly S-shaped curve. The inferior lamella is of light rose-brown color, low, but shortly visible in front view, not reaching the edge of the peristome, considerably thickened on the upper rim, channel-like arching over to the junction of superior lamella and the spiralis. Subcolumellar lamella short, deeply immersed, but shortly visible in very oblique view in the aperture, terminating widely separated from the lower end of the lunella. Principal plica white, high, thin, dorso-lateral, half a whorl long, slightly surpassing the upper end of lunella and shortly separated from that. The lunella is dorso-lateral, well developed as a low and wide ridge, weakly and evenly arched, brownish-rose colored and darker than the surrounding inside of the shell. The clausilium is strongly curved lengthwise and transversely, evenly rounded at the end, close to the subcolumellar lamella, but slightly separated from the lunella.

Notes on paratype: One specimen, same locality as the type, partly bleached, somewhat damaged, has the earlier whorls more slowly tapering and the whitish band below the suture a little broader. In all other features, this paratype corresponds perfectly with the type.

Measurements are in mm.:

Alt.	Diam.	Alt. apert.	Lat. apert.	Whorls	
34,8	6,2	6,9	5,8	8¾	Type
32,0	5,8	6,6	5,4	8¾	

Type locality: Eastern Bolivia: Yungas de Palmar, 700 m., tropical rain forest. Collected by Mr. Rudolf Zischka, after whom this new species is named.

Material: Type WW 1368 in the author's collection; 1 paratype in the Academy of Natural Sciences of Philadelphia.

Comparisons: *C. zischkai* can only be compared with the group of *C. bartletti* Adams (= *obesa* Haas), comprising *reyrei* Jousseaume, *huancabambensis* Rolle, *juninensis* M. Smith and *binkiae* Pilsbry, all described from the subtropical and tropical forest of Ecuador and eastern Peru, and all at hand except *reyrei.* Our novelty is nearest to *binkiae* from south eastern Peru, which has (1) the same evenly spaced, strong, low and rounded riblets, (2) the same regularly and obtusely denticulate suture, and (3) the same very obtuse apex. But *zischkai* is twice as high as *binkiae,* is decidingly less fusiform, has the riblets more oblique on the last three whorls and its inferior lamella is

channel-like arched towards the superior lamella and spiralis, not plain as in *binkiae*. For its height, *zischkai* is nearest to *juninensis* of 30 mm. length, but this is (1) attenuate above, (2) has the suture irregularly crenulate and (3) its riblets are finer, more crowded, often interrupted, often changing the direction and less slanting. Only *bartletti* (= *obesa*) has a slightly arched inferior lamella; but *zischkai* differs from that by greater length, straightened outlines, and the sculpture of surface, which is in *obesa* intermediate between *binkiae* and *juninensis*.

I consider the above mentioned species of the group of *C. bartletti* only subspecifically distinct, in the sense of geographical races. But I regard *zischkai* specifically different for the following characters: (1) shell less ventricose; (2) height of last whorl in front view, including expansion of peristome, contained 2½ times in altitude of shell, whereas in *bartletti* and its races this proportion is 1 : 2.

TWO NEW SUBSPECIES OF NEPTUNEA DECEMCOSTATA

By ARTHUR HADDLETON CLARKE, JR. *

In 1953, an extensive collection of deep water marine mollusks was presented to the Department of Mollusks of the Museum of Comparative Zoology by Mr. W. C. Schroeder, Associate Curator of Fishes at that institution. The specimens had been obtained during a faunal survey of the continental slope area of northeastern North America conducted by the Woods Hole Oceanographic Institution in 1952 and 1953. Operations were under the direction of Mr. Schroeder, and the trawler *Cap'n Bill II* had been used for the survey. A report on these mollusks has been published (Clarke, 1954).

From the material collected, apparently considerable variation in shell form existed between lots of *Neptunea decemcostata* Say. All the western Atlantic specimens of *Neptunea* in the Museum of Comparative Zoölogy and the United States National Museum were examined and measured, and many Eastern Atlantic specimens were studied also. The existence of two mor-

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phometrically divergent allopatric populations geographically removed from the main population of *decemcostata* became apparent. These newly defined assemblages are here described as subspecies of *decemcostata.*

Such a treatment is admittedly conservative, and further researches may show that one of these (*clenchi*) is a distinct species standing between *N. despecta* Linné (*sensu latu*) and *N. decemcostata.* The world-wide problem will be studied further.

Neptunea decemcostata clenchi, **new subspecies.** Plate 7, fig. 1.

Adult shell about 80 to 128 mm. in length, sturdy, spire greatly extended, imperforate and possessing numerous reddish-brown, revolving ribs; ground color brownish-white; whorls eight to nine and convex, and spire produced at an angle of about 48° to 58°. Aperture sub-ovate with the siphonal canal somewhat extended and rather broad; outer lip sharp and crenated at the upper margin; umbilical and parietal areas covered by a rather narrow callus; columella produced as a shallow sigmoid curve; and suture slightly impressed. The sculpture consists of numerous reddish-brown spiral chords which are usually somewhat darker than the ground color; major chords approximately equidistant and varying from 12 to 14 on the body whorl with about 4 showing on the earlier whorls; peripheral chord largest and defining a wide convex shoulder with one minor chord between it and the suture; sutural chord faint or absent; other chords decreasing in thickness and becoming extinct near the base of the siphonal canal. A series of minor chords between the major ones may also be present. The lower whorls are also sculptured with fine, revolving threads which are restricted to the area between the chords. Axial lines of growth are numerous, prominent, and coarse. The operculum is mahogany brown, corneous and unguiculate with an apical nucleus and coarse concentric growth lines; inner side of operculum with a thickened marginal callus and concentric ridges in the scar area.

Remarks. The outstanding characteristic of the benthic *Neptunea decemcostata clenchi* is its long, slender form. This will immediately distinguish it from the normally sub-littoral *N. decemcostata* Say. In addition, *clenchi* exhibits eight to nine whorls and twelve to fourteen major spiral chords on the body whorl, while *decemcostata* has six to eight whorls and nine to eleven major spiral chords. Also, the chords on *clenchi* are only slightly raised and of moderate prominence, but *decemcostata*

has strongly elevated and very prominent chords. See further remarks under discussion.

Types. The holotype is number 202152 in the Museum of Comparative Zoology. It was taken from a depth of 340 to 350 fathoms at 42° 46′ N. latitude and 63° 22′ W. longitude (approximately 100 miles E.S.E. of Cape Sable, Nova Scotia, *Cap'n Bill II* station 88) by members of the staff of the Woods Hole Oceanographic Institution during a faunal survey of a portion of the continental slope. Two paratypes were taken at the same station (M.C.Z. no. 202153).

	Length (L)	Width (W)	W/L
Holotype	110 mm.	48 mm.	0.44
Paratype	84	40	0.48
Paratype	127	59	0.46

Specimens examined were from: Station 86, 42° 23′ N. Lat., 64° 58′ W. Long. in 230–245 fms.; Station 88 (type locality) 42° 46′ N. Lat., 63° 22′ W. Long. in 340–350 fms.; Station 95, 42° 45′ N. Lat., 63° 47′ W. Long. in 330–340 fms.; Station 104, 42° 40′ N. Lat., 64° 08′ W. Long. in 350–380 fms.; Station 165, 42° 42′ N. Lat., 63° 47′ W. Long. in 360–370 fms.; Station 173, 42° 40′ N. Lat., 64° 10′ W. Long. in 240–270 fms.; Station 182, 42° 28′ N. Lat., 64° 31′ W. Long. in 280–305 fms.; Station 184, 42° 23′ N. Lat., 64° 52′ W. Long. in 265–295 fms.

These stations are all on the continental slope and are approximately 80 miles southeast of Cape Sable, Nova Scotia. All specimens were obtained by the *Cap'n Bill II* survey, to which the station numbers refer.

I take pleasure in naming this subspecies in honor of Dr. William J. Clench, whose helpful guidance and sound judgment have been a valuable aid on many occasions, and under whose watchful eye the basic work on this paper was done while the author was a graduate student at Harvard University.

Neptunea decemcostata turnerae, new subspecies. Plate 7, fig. 2.

Adult shell about 60 to 85 mm. in length, sturdy, spire slightly extended, sub-imperforate and possessing numerous strong, reddish-brown, revolving ribs; ground color brownish-white; whorls six to seven and convex, and spire produced at an angle of about

68° to 75°. Aperture sub-ovate with the siphonal canal short and broad; outer lip sharp and crenated at the margin; parietal callus thin and sometimes partially lacking; umbilicus shallow or lacking and usually covered by the callus; columella produced as a shallow sigmoid curve; and suture well marked. The sculpture consists of numerous heavy, raised spiral chords which may be the same or somewhat darker than the ground color; chords approximately equidistant and varying from 9 to 10 on the body whorl with 2 to 3 showing on the earlier whorls; peripheral chord largest, set at some distance from the suture and forming the edge of a wide, excavated shoulder; other chords decrease in thickness anteriorly and become extinct at the base of the siphonal canal; and chords barely visible within the aperture as shallow grooves. The lower whorls are also sculptured with numerous fine, revolving threads which occur both between and on the spiral chords. Axial lines of growth are numerous, prominent, and coarse. The operculum is mahogany brown, corneous and unguiculate with an apical nucleus and coarse concentric growth lines; inner side of operculum with a thickened marginal callus and concentric ridges in the scar area.

Remarks. The short, obese form and abbreviated spire of the localized *Neptunea decemcostata turnerae* are the most obvious and reliable differential characteristics between it and the widely distributed *N. decemcostata decemcostata* Say. In addition, *turnerae* has six to seven whorls and nine to ten major spiral chords on the body whorl, whereas *decemcostata* has six to eight whorls and nine to eleven major spiral chords. Also, the chords of *turnerae* are usually somewhat more prominent than those of *decemcostata*. See discussion for additional comments.

Types. The holotype is number 202151 in the Museum of Comparative Zoology and was taken by A. E. Verrill at Grand Manan Island, New Brunswick, Canada. Fourteen paratypes from the same station are in the M.C.Z. collection (No. 72584).

	Length (L)	Width (W)	W/L
Holotype	62 mm.	43 mm.	0.69
Paratype	68	48	0.71
Paratype	61	40	0.66

Specimens examined were from. New Brunswick: Grand Manan Island (type locality) (Museum of Comparative Zoölogy, United States National Museum). Maine: Lubec, Washington Co.; Trenton Point, Hancock Co. (both Museum of Comparative Zoölogy).

I take pleasure in naming this subspecies in honor of Dr. Ruth D. Turner, who has cheerfully given many hours of valuable help in connection with this paper and other related problems and who is doing a great deal to advance the science of malacology.

Discussion

Neptunea decemcostata occurs from the Grand Banks and the Gulf of St. Lawrence southwestward to the latitude of North Carolina. North of Cape Cod, specimens may be found at stations ranging from just below low tide line to beyond the outer edge of the continental shelf, but south of New England the species is known only from the upper continental slope. As far as is now known, individual shell form does not vary to any significant degree throughout this range except in the two small areas populated by *clenchi* and *turnerae.* The type locality of *Fusus 10-costata* given by Say: "the coast near Boston," is near the center of the range of typical *decemcostata,* and his measurements (3.3 inches long and 1.9 inches wide) give a width to length ratio of 0.576, and show that he had the common form. His description is also of a typical specimen.

The elongate subspecies *N. d. clenchi* has been found only over a small area of the continental slope about 80 miles southeast of Cape Sable, Nova Scotia, in depths ranging from about 245 to 360 fathoms. Specimens from similar depths taken at points further southwest are typical *decemcostata.* No collections have been made at these depths from points immediately northeast of the known range of *clenchi,* or in deeper water near the area worked. Further investigations may therefore extend the known geographic and bathymetric range of this subspecies.

The short-spired subspecies *N. d. turnerae* is known only from the area between Grand Manan Island, New Brunswick, and Trenton Point, Maine (near Mount Desert Island). How far eastward the subspecies occurs is unknown because of lack of records, but specimens from Digby and from Halifax, Nova Scotia, are typical *decemcostata.* A large number of lots from stations southwest and south of Trenton Point have been examined, and they are all normal *decemcostata.* Specimens from Eastport, Maine seem to be a mixture of *decemcostata* and *turnerae* however, and this is the only area known to the author where a heterogeneous population occurs. As is well known,

such mixtures are to be expected at zones of contact between subspecies.

Application of the 75% rule adds strength to the hypothesis that *clenchi* and *turnerae* are subspecifically distinct from *decemcostata.* Utilizing the largest lots of specimens available, and applying the statistical principles for subspecific discrimination suggested by Mayr (Mayr et al., 1953) the following data were computed (N = number of specimens; W/L = ratio of maximum width to length, or index of obesity; and S.D. = standard deviation from the mean). Localities of shells tabulated are as follows: *N. d. clenchi,* all available specimens from type area. Typical subspecies, population A, from off Flemish Cap, Grand Banks, 200–250 fms.; B, from off Cape Ann, Mass., 25–60 fms. *N. d. turnerae,* 2 lots from Grand Manan Island.

			Width ÷ length		
Subspecies	No.	Max.	Min.	Mean	S.D.
clenchi	16	.54	.44	.491	.026
decemcostata (population A)	16	.61	.53	.580	.021
decemcostata (population B)	23	.62	.54	.583	.029
turnerae	24	.71	.61	.662	.025

From the above data, the C.D. (Coefficient of Difference) was calculated for the populations to be compared. A C.D. of 1.28 indicates that 75% of the individuals of population I are different from 97% of the individuals of population II, or that 90% of population I is different from 90% of population II (90% non-overlap). This is the conventional level of subspecific difference, and higher C.D. or non-overlap (N.O.) values are progressively more significant.

The C.D. and non-overlap values derived from the above data are as follows: *clenchi-decemcostata* (A), 1.89 C.D., 97% N.O.; *clenchi-decemcostata* (B), 1.67 C.D., 95% N.O.; *turnerae-decemcostata* (A), 1.78 C.D., 96% N.O.; *turnerae-decemcostata* (B), 1.46 C.D., 94% N.O.

From these figures it may be seen that the degree of difference in index of obesity between *clenchi* and *decemcostata* and between *turnerae* and *decemcostata* is well above the conventional level necessary for subspecific discrimination. Similar calculations using other shell characteristics would have given com-

1, *Neptunea decemcostata clenchi* Clarke, type. 2, *N. d. turnerae* Clarke, type. 3, *N. d. decemcostata* (Say). All figs. × 1.2.

Panope bitruncata

parable results. These facts, when considered together with the allopatric distribution patterns involved, qualify these populations as distinct subspecies.

ACKNOWLEDGMENTS

In addition to Drs. W. J. Clench and R. D. Turner, who have been cited, I wish to thank Dr. Harald Rehder for his generous cooperation in loaning for study the entire United States National Museum collection of Western Atlantic specimens of the genus *Neptunea*.

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A LIVING SPECIMEN OF THE EAST COAST GEODUCK FROM ST. AUGUSTINE, FLORIDA

By MALCOLM C. JOHNSON

Marineland Research Laboratory, Marineland, Florida

On August 14, 1954 an unusual clam was taken from a mudbank in the Matanzas River, St. Augustine, Florida, by Mr. Verle A. Pope of that city (Pope, 1954).[1] The clam was tentatively identified by me as being *Panope bitruncata* Conrad. Mr. Percy Morris of the Peabody Museum at Yale, later confirmed this identification from a photograph.

The robust shell was evenly rounded anteriorly and trun-

[1] A captioned photograph of Pope and his specimen appeared in the December, 1954 edition of the Quarterly Journal of the Florida Academy of Sciences.

cated behind; it was offwhite in color with prominent concentric growth rings. The shell was 5.75 inches in length, 4.25 inches in depth and had a thickness of 3.0 inches. The anterior gape measured 3/8-inch at the widest point and extended from the forward edge of the hinge to the mid-ventral margin. The valves of the shell met for a distance of one inch in this area; the posterior gape then extended to the ligament and measured two inches at the widest point.

The heavy "neck" could not be completely withdrawn into the shell. It was not measured when extended while the animal was fresh. However, it was 7.50 inches long after the clam had been preserved in sea-water formalin for several weeks.

Mr. Pope remembers seeing such a clam as a boy. He remarked on this in my presence several years ago shortly after he had noticed what he described as its characteristic "squirt." While boating August 14, 1954 his curiosity was further aroused when he found a shell of *Panope* on a mudbank. He secured a shovel, returned and succeeded in uncovering the one specimen described here. The substrate from which it was taken is alluvial mud typical of the salt marshes of the Southeastern Coast. However, the bank which is alternately inundated and exposed by the tides is overlain with sand deposited by the fast flowing waters of the main river channel and will support a man without miring. Pope estimated the body of the clam was four feet below the surface. To date no others have been found.

The rarity of this clam is attested by the fact that in an area where a good segment of the population traditionally takes its living from the sea or its margins, only one or two persons have claimed any knowledge of its presence in spite of much local publicity. Their statemenst were typically prefaced thusly: "Many years ago——."

Smith (1937) reported that individuals living in easily movable material such as sand or fine mud are thinner, longer and less distorted than those associated with gravel. This could imply that he had seen living specimens. However, this is doubtful since he had improperly oriented the shell and described it as "obliquely cut off at the anterior end." Morris (1947) described the shell of *P. bitruncata* as being quite smooth; the pronounced sculpturing of the living specimen would indicate that the ones he had in hand were quite old and

eroded. Abbott (1954) stated that he had never seen a living specimen and that it was probably extinct.

The clam is presently in the collection of the Marineland Research Laboratory.

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VENTRIDENS INTERTEXTUS EUTROPIS LIVES HERE

By MARGARET C. TESKEY

In 1935 Dr. Henry A. Pilsbry and Mr. Cyril Harvey collected in Central Tennessee a single specimen of an acutely carinate "dead" shell, subsequently described as *Ventridens intertextus eutropis* Pilsbry, a new subspecies. Since then the type locality has been searched by other collectors without yielding another specimen of this unique mollusk.

In July, 1955 the writer made a chance stop and hurried search of a small wooded area some sixty miles northwest of the type locality and collected two living specimens of *Ventridens intertextus eutropis* Pilsbry which unfortunately were cleaned before they were recognized. These specimens, one adult, one immature, have been deposited in the collection of the U. S. National Museum.

In September Mr. Leslie Hubricht visited the site and collected seven specimens, three living but immature, four adult but dead. And on December 17th and 23rd, the writer was again in the area, devoting a half hour to collecting on each occasion, and each time was rewarded with two specimens, dead to be sure but adult and a prize considering that the logs beneath which they were found were covered by crusted snow.

Because this site has yielded thirteen specimens of a hereto-

fore rare subspecies, directions are presented for reaching it, as a guide to other collectors.

At the extreme northeastern edge of Cheatham County, Tennessee, it is about halfway between Nashville and Clarksville, on the east side of U. S. highway 41A, exactly 1.7 miles south of the intersection of Tennessee highway 49 which appears on some maps as the village of Pleasant View. The heavily wooded area of perhaps fifty acres covers both slopes of a shallow ravine; the predominant growth is oak and hickory and there is little underbrush save for a bramble which takes a toll of all but the most rugged of collecting garb.

This woodlot is bordered on the north by a gravel road which affords a turnout and parking space, necessary since the main highway is narrow at this point and heavily traveled. Because of this important fact, collectors should visit the spot as soon as possible. For U. S. 41 together with its alternates is the most direct route between Chicago and the gulf coast cities of Northwestern Florida. Much of it is already a divided highway, other portions are undergoing a widening process; hence the future will certainly see at least part of an especially rewarding collecting area disappear beneath a ribbon of asphalt.

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LAND SNAILS FROM LOUISIANA

By LESLIE HUBRICHT

During July, 1955 the author spent two days in Louisiana collecting land snails. Although only fifty-two lots, belonging to 17 species were collected, they are from a region in which the land snail fauna is poorly understood. For this reason it seems advisable to publish the records.

Polygyra leporina (Gould). Grant Parish: 1.8 miles south of Bentley.

Polygyra dorfeuilliana Lea. Claiborne Parish: 11 miles southwest of Homer.

Stenotrema leai aliciae (Pilsbry). Calcasieu Parish: 2.5 miles west of Sulphur. Evangeline Parish: Beaver. Allen Parish: 3.3 miles northwest of Oakdale. Vernon Parish: 1.5 miles west of Simpson. Rapides Parish: 2.5 miles east of flatwoods. Grant Parish: 1.8 miles south of Bentley; just west of Pollock; 5 miles northeast of Pollock.

Mesodon thyroidus (Say). Calcasieu Parish: 2.5 miles west of Sulphur. Grant Parish: just west of Pollock; 5 miles northeast of Pollock. Ouachita Parish: 6 miles southwest of West Monroe.

Mesodon inflectus (Say). Calcasieu Parish: 2.5 miles west of Sulphur. Evangeline Parish: Beaver. Vernon Parish: 1.5 miles west of Simpson. Grant Parish: 1.8 miles south of Bentley; just west of Pollock; 5 miles northeast of Pollock. LaSalle Parish: 7 miles southwest of Trout.

Triodopsis cragini (Call). Grant Parish: just west of Pollock. Claiborne Parish: 11 miles southwest of Homer; 3 miles southwest of Summerfield.

Triodopsis albolabris (Say). Ouachita Parish: 6 miles southwest of West Monroe.

Haplotrema concavum (Say). LaSalle Parish: 7 miles southwest of Trout.

Retinella indentata (Say). LaSalle Parish: 7 miles southwest of Trout.

Retinella indentata paucilirata (Morelet). Claiborne Parish: 11 miles southwest of Homer.

Mesomphix vulgatus H. B. Baker. Vernon Parish: 1.5 miles west of Simpson. LaSalle Parish: 7 miles southwest of Trout.

Ventridens demissus (Binney). Vernon Parish: 1.5 miles west of Simpson. Grant Parish: just west of Pollock; 5 miles northeast of Pollock. LaSalle Parish: 7 miles southwest of Trout.

Ventridens intertextus (Binney). Calcasieu Parish: 2.5 miles west of Sulphur. Evangeline Parish: Beaver. LaSalle Parish: 7 miles southwest of Trout. Claiborne Parish: 11 miles southwest of Homer.

Anguispira crassa Walker. Calcasieu Parish: 2.5 miles west of Sulphur. Evangeline Parish: Beaver. Vernon Parish: 1.5 miles west of Simpson. Grant Parish: 1.8 miles south of Bentley. Ouachita Parish: 6 miles southwest of West Monroe. Claiborne Parish: 11 miles southwest of Homer.

Philomycus carolinianus (Bosc). Calcasieu Parish: 2.5 miles west of Sulphur. Evangeline Parish: Beaver. Richland Parish: 8.5 miles west-northwest of Alto. Ouachita Parish: 6 miles southwest of West Monroe.

Pallifera marmorea Pilsbry. Vernon Parish: 1.5 miles west of Simpson. Grant Parish: just west of Pollock. These specimens are paler than those from Missouri and Arkansas and do not have the reddish margin to the foot.

MEGAPALLIFERA, new subgenus

Animal large, sometimes reaching 100 mm. in length when extended in crawling. The margin of the foot is never reddish, being either grayish or white. The jaw with from 10 to 16 ribs. There is a pilaster extending from the lower vagina into the upper atrium.

Type species: *Pallifera mutabilis* Hubricht. 1951, Naut. 65:57.

This subgenus contains three known species: *P. mutabilis* Hubricht, *P. ragsdalei* (Webb), and *P. weatherbyi* W. G. Binney. Because of their large size, these species have been confused with species of *Philomycus*. Most of the records for *Philomycus flexuolaris* Rafinesque from west of the Appalachian Mountains are based on *P. mutabilis*.

Pallifera mutabilis Hubricht. Grant Parish: 12 miles south of Colfax.

Helicina orbiculata (Say). Evangeline Parish: Beaver.

HAPLOTREMA KENDEIGHI WEBB

By LESLIE HUBRICHT

A new subspecies of *Haplotrema concavum* (Say) was described by Glenn R. Webb in 1951 (Trans. Kans. Acad. Sci. 54: 78–82) from the Great Smoky Mountains National Park and named *H. c. kendeighi*. The subspecies was distinguished by the following shell differences: "*Haplotrema concavum kendeighi* is particularly characterized by the pronounced inflation of the lower part of the aperture—causing the lower peristome to join the base at about a 90 degree angle and helping give the shell a quadroid aperture. The new subspecies differs from typical *H. c. concavum* in: (1) having a markedly asymmetrical aperture; (2) in lacking sigmoid curvature of the dorsal peristome; (3) in the thinner, more polished, more translucent, greener-colored shell; (4) in the wider spacing of the growth-zones; and (5) in the absence or sparsity of revolving striae."

A study of a large series of shells of *Haplotrema concavum* collected over most of its range shows that none of the above characters, either singly or in combination, can be used to divide

Haplotrema of the eastern United States. There is complete intergradation in all shell characters.

In the vicinity of Blowing Spring, Cliff Ridge, Nantahala Gorge, Swain Co., North Carolina, there are two distinct sizes of *Haplotrema* occuring together. Measurements of some specimens of the two sizes are as follows:

Diam.	Ht.	Umb. D.	Wls.	H/D	D/U
22.4	9.5	7.4 mm.	5.5	.42	3.0
21.4	9.3	6.7 mm.	5.3	.44	3.2
21.2	10.6	6.5 mm.	5.4	.50	3.3
19.5	9.6	5.4 mm.	5.4	.49	3.6

Diam.	Ht.	Umb. D.	Wls.	H/D	D/U
16.4	7.2	5.0 mm.	5.3	.45	3.3
16.4	7.1	4.9 mm.	5.3	.43	3.4
15.9	7.4	4.5 mm.	5.2	.47	3.3
15.4	6.8	4.6 mm.	5.0	.44	3.3

The above measurements show that there is no difference in proportions between the two forms. There is no difference in the development of the spiral sculpture, it being very weak. There is apparently a difference in breeding season. On June 6, 1953, mature specimens of the large form were common, but specimens of the small form were all immature. On August 31, 1952, mature specimens of the small form were found, but mature specimens of the large form were rare.

When they were being collected, one conspicuous difference was noted in the color of the foot. The foot of the large form was a dull yellowish-gray, while the foot of the small form was bright blue. On dissection, the small form was found to have a cloaca at least twice the size of that of the large form. *Haplotrema c. kendeighi* from the type locality and from Clingmans Dome was found to have a blue foot and a large cloaca. The large form is *H. concavum* and the small form *H. c. kendeighi,* and, in view of the anatomical difference and since the two occur together without intergradation, the latter, despite the absence of shell differences, is undoubtedly a distinct species.

Although the shells of *Haplotrema kendeighi* cannot be distinguished from shells of *H. concavum* from northern Iowa or southern Michigan, they can be readily separated from those found within its range in western North Carolina and eastern Tennessee where *H. concavum* reaches its maximum size.

Haplotrema kendeighi is known from the following localities: Tennessee: Sevier Co.: slopes of the Chimneys above the camp area on the west prong of Little Pigeon River near Tenn.-71, in mixed-hardwoods deciduous forest (Type Locality); 6600 ft., Clingmans Dome; Mt. LeConte (Clench & Archer). North Carolina: Swain Co.: near Blowing Spring, Cliff Ridge, Nantahala Gorge.

FAMILY NAMES IN PULMONATA

By H. BURRINGTON BAKER

The original international code for zoölogical nomenclature was established (1905) in the hope that uniformity might be attained. Some such artificial rules were thought necessary for the names of genera down to subspecies because of their great numbers. Names above the genera, since they were less numerous, wisely were left to scientific judgment.

Although, as everyone knows, more useless name-changes have taken place since 1905 than in any other half century of taxonomic history, the new articles 4 and 5 (Follett, 1955, "Not published") apparently intend to extend the priority rule to groups (taxons) up towards orders. In addition, so far as its dating is concerned, each "family-group name" would be regarded as equal, regardless of its termination, and independent of the synonymy or even the homonymy of its "type genus." After 50 years, this would reverse the old article 5 completely.

The most disturbing feature of the new article 5 is its 3rd paragraph, which not only predates names but actually determines a "type species" for each family or subfamily which contains a prior synonym based on a preoccupied (homonymous) generic or subgeneric name. For some of the worst changes involved, see Achatinidae (*Cecilioides*), *Brachypodella, Bulimus,* Euconulinae, *Psiloicus, Pupillidae* (Gastrocoptinae), *Scolodens,* Streptaxidae (*Zophos*), Vitrinidae (Vitreinae & Zonitinae) and Xestidae.

An alphabetic list of the families of Pulmonata follows, with included subfamilies arranged chronologically under each. It

is presented simply as an argument against these proposed amendments; none of the changes is accepted. To illustrate how and what names are employed at present, references cite Pilsbry's "Land Mollusca of North America" (LMNA:1 means volume 1, page 1; LMNA2 is vol. 2) and to Thiele's "Handbuch der systematischen Weichtierkunde," part 2 (HSW:461 means page 461). Names which are, or would become synonyms are in parentheses.

Of course, no hope is offered that these hasty arrangements would be final. Probably all the changes involved would not be discovered before the end of the century, and by that time a new set of rules will start the cycle all over again.

Acav-inae Pilsbry, 1895; -idae P., 1900, HSW:647. SubF: Clavatorinae (-idae Th. in K., 1926, HSW:648). Caryodinae (-idae T. in K., 1926, HSW:649; Hedleyelloidea & Pedinogyroidea I., 1942). F. of Helicoidea?

Achatin-ae Swainson, 1840 (SubF); -inae Adams, 1855; -idae Tryon, 1867, LMNA2:169, HSW:558. SubF: C-inae, *Cecilioides* Fér., 1814 (Caeciliae [1] Mörch, 1864, F.; Caecilianellinae [2] Crosse & Fischer, 1877; -idae Bgt., 1887; Ferussacidae Bgt., 1883; -iidae HSW:546; -iinae HBB., 1945, LMNA2:184; Opeatinae [3] HSW:552, genus LMNA2:181). Stenogyrinae [4] Wenz, 1923 (-idae C. & F., 1877; Subulininae C. & F., 1877, LMNA2:170–180; -idae Thle., 1926, HSW:549; Obeliscinae & Rumininae (-idae Wenz, 1923) HSW:554; Cryptelasminae Jaume & Fuentes, 1943). Coeliaxinae Pilsbry, 1907, HSW: 556 (-idae Wenz, 1923). F. of Achatinoidea.

Achatinellidae: Man. Conch. 21–22, HSW:498; see Helicteridae.

Acrore-idae (Acroriidae [1] Wenz, 1923). F. of Limnophila?

Ailly-idae HBB., 1930, genus HSW:666. F. of Heterurethra.

Amastr-inae Pilsbry, 1911; -idae P., 1914, HSW:500. SubF: Leptachatininae P. & Cooke, 1914, HSW:500 (-ini Ckll., 1913). F. of Cionelloidea.

Amphibol-idae Gray, 1840, HSW:470 (Ampullaceridae [2] Troschel, 1845). F. of Thalassophila.

Ancyl-idia Raf., 1815 (SubF); -idae Dall, 1870, HSW:482 (Acroloxinae HSW:484). SubF: Neoplanorbinae Hannibal, 1912. Laevapicinae H., 1912 (-idae 1914; Ferrissiinae [4] B. Walker, 1917). Rhodacminae W., 1917. Pseudancylinae & Ancylastrinae W., 1923. F. of Ancyloidea.

[1] "Type genus" a clear homonym; i.e., preoccupied.

[2] "Type genus" an objective synonym; i.e., with same type species.

[3] "Type genus" a misusage; i.e., with wrong type species.

[4] "Type genus" a subjective synonym; i.e., with different type species.

Aper-idae[2] Mlldff., 1902, HSW:726 (Chlamydephoridae Ckll., 1935). F. of SuperF. Rhytididae.

Arion-idae Gray in Turton, 1840, LMNA2:660, HSW:600. SubF: Binneyinae Ckll., 1891, LMNA2:732, HSW:601. Oopeltinae Ckll., 1891, HSW:604. Ariolimacinae Pils. & Van., 1898, LMNA2:706, HSW:601. Anadeninae Pils., 1948, LMNA2:676. F. of Arionoidea.

Ariophantidae: HSW:611; see Xestidae.

Athoracophor-idae Fischer, 1883, HSW:495 (Janellidae[1] Gray, 1853). SubF: Aneiteinae (-adae Gray, 1860; Aneitinae Gr. & Hffm., 1924). F. of Heterurethra or Tracheopulmonata.

Auricul-ae Férussac, 1821; -adae Gray, 1824; -idae Risso, 1826 (Ellobiidae[2] Adams, 1855, HSW:463). SubF: C-inae (Conovulidae[2] Clarke, 1850; Melampidae Stimpson, 1851; -inae Adams, 1855; -odinae C. & F., 1880). Scarabinae[2] (Pythiinae Odhner, 1925) & Pedipedinae (HSW:463) C. & F., 1880. Cassidulinae[1] O., 1925. F. of Actophila.

Brachypodella Beck, 1837: -idae (Cylindrellidae[1] Tryon, 1868; Urocoptidae Pils. & Van., 1898, LMNA2:103, HSW:668). SubF: Berendtinae Cr. & Fisch., 1872 (Eucalodinae C. & F., 1873; -iinae HSW:668; -iidae Str. & Pfeffer, 1879). Microceraminae Pils., 1904, LMNA2:107, HSW:671. Holospirinae Pils., 1946, LMNA2:111. F. of SuperF. Orthalicidae.

Bradybaenidae: LMNA:15; see Eulotidae.

Bulimin-ida[4] Clessin, 1879; -idae Kobelt, 1880 (Enidae Pils. & Cooke, 1914, HSW:517; Chondrinidae[3] Steenberg, 1925). SubF: Cerastinae Wenz, 1923 (*Cerastua*,[2] 1928; Pachnodinae & -idae S., 1925; Napaeinae Wagn., 1927, HSW:523). Chondrulinae[4] Wenz, 1923 (-idae Wagner, 1927; Jaminiinae HSW:517). F. of Pupilloidea.

Bulimulidae: Man. Conch. 11–14, LMNA2:1, HSW:651; see Orthalicidae.

Bulimus[3] Scopoli, 1786, Brug., 1789, not Scopoli, 1777: type *Helix oblonga* Müller: -idae Guilding, 1828; -ida Beck, 1837; -inae Adams, 1855, etc., for almost a century. See *Psiloicus* and Strophocheilidae.

Camaenidae: Man. Conch. 9, LMNA:410; see *Lucerna*.

Carychi-adae Jeffreys, 1829; -inae C. & F., 1880, HSW:464; -idae Wenz, 1923, LMNA2:1051. F. of Actophila.

Caryodidae: HSW:649; see Acavidae.

Cepolidae: see Xanthonycidae.

Cerion-idae[5] Pilsbry, 1901, LMNA2:158, HSW:667 (Pup-adae[2] Fleming or Guilding, 1828; -inae Adams, 1855; -idae Gill, 1871. On *Pupa* Lamarck, 1801, or Draparnaud, 1801?). F. of Cerionoidea.

Chilin-idae Adams, 1855, HSW:472. F. of Limnophila.

[5] "Type genus" now on official list.

Cionell-ida Clessin, 1879; -idae Kobelt, 1880, LMNA2:1045 (Cochlicopidae [3] Pilsbry, 1900, HSW:502; Spelaeoconchinae Wagn., 1927). F. of Cionelloidea.

Clausili-eae [5] Mörch, 1864(F); -idae Stoliczka, 1871; HSW:526 (Baleinae Wagner, 1922; Laminiferinae Wenz, 1923; Mentissoideinae & Fusulinae Lindholm, 1924). SubF: Alopiinae Wagner, 1921 (Garnieriinae Hffm., 1928). Phaedusinae Wagner, 1922, HSW:527. Neniinae Wenz, 1923, HSW:533 (Neniastrinae [2] HBB., 1930). Marpessinae Wenz, 1923 (Cochlodininae [2] Hffm., 1928, HSW:540). Triptychiinae & Filholiidae Wenz, 1923. F. of SuperF. Orthalicidae?

Clavatoridae: HSW:648; see Acavidae.

Cochlicopidae: [3] HSW:502; see Cionellidae & Oleacinidae.

Corillidae: HSW:585; see Plectopylididae.

Dorcasi-idae Thle., 1926, HSW:646. F. of Cerionoidea.

Ellobiidae: [2] HSW:463; see Auriculidae.

Enidae: HSW:517; see Buliminidae.

Endodontidae: Man. Conch. 9, LMNA2:565, HSW:566; see Punctidae.

Euconul-inae HBB., 1928, LMNA2:233; HSW:613, genus (Conulinae [1] Strebel & Pfeffer, 1879; Durgellinidae [4] & Hedleyoconchidae [4] I., 1941). SubF. or Tribe: Microcystinae Thiele, 1931, HSW:618 (-idae I., 1937; Trochonaninidae [3] Germain, 1921; -inae HSW:616; Liardetiae & Philonesiae HBB., 1938; Fanulidae [4] & Advenidae [4] I., 1945). F. or primary SubF. (which see): Xestinae (-idae, 1941), Helicarioninae Godwin-Austen, 1888 (-idae, 1909), and Urocyclidae Simroth, 1889. Incertae sedis: Cystopeltinae Ckll., 1891, HSW:625. Sophininae Blanford & G.-A., 1908, HSW: 637. Chroninae HSW:626. F. of Limacoidea.

Eulot-idae [2] Wenz, 1923; -inae Ihering, 1929 (Fruticicolidae [4] Lindholm, 1927, HSW:688; Buliminopsinae Hffm., 1928; Bradybaenidae Pils., 1939, LMNA:15; Aegistinae Habe, 1955). SubF: Helicostylinae Hffm., 1928, HSW:688 (Cochlostylinae [4] Ihering, 1929). F. of Helicoidea or SubF. of Xanthonycidae.

Ferussacidae: Man. Conch. 19, HSW:546; see Achatinidae (*Cecilioides*).

Fruticicolidae: [4] HSW:688; see Eulotidae & Hygromiidae.

Gadini-adae [2] Gray, 1840; -idae Dall, 1870, HSW:470. F. of Limnophila!

Haplotremat-idae HBB., 1925, LMNA2:201, HSW:723, in part (Circinariidae [3] Pilsbry, 1898, in part). F. of SuperF. Rhytididae.

Helicarion-inae Godwin-Austen, 1888, HSW:637; -idae Kobelt, 1909 (Pseudotrochatellinae Wagner, 1905, genus HSW:82; Ereptinae HSW:614). SubF. or Tribe: Sesarinae Thiele,

1931, HSW:620 (Kaliellinae HSW:612, type genus; Geotrochidae I., 1941; Nitoridae[4] I., 1944, section HSW:617). SubF. of F. Euconulinae, or F. of Limacoidea.

Helicellinae[3] Wenz, 1923, HSW:702; -idae LMNA:14; see Hygromiidae. Not Helicellinae[1] Adams, 1855; -idae Tryon, 1866; see Vitrinidae (Vitreinae & Zonitinae) and Helicidae.

Helic-inia[5] Raf., 1815 (F); -idae Gray, 1824, LMNA:1 (Helicellinae[3] Adams, 1855; Xerophil-ae[3] Mörch, 1864; -inae Wagner, 1927; Theb-ea[2] Wenz, 1923, -inae Germ., 1929; Euparyphinae[2] Perrot, 1939. Murellinae Hesse, 1920). SubF: A-inae (Ariantidae[4] Mörch, 1864; Campylaeinae Bttg. & Wenz, 1921; Helicigoninae[2] HSW:713). Helicodontinae Hesse, 1918, HSW:711. Leptaxinae Wenz, 1923, HSW:715. See also Hygromiidae (SubF. of Helicidae, HSW:702) & Xanthonycidae. F. of Helicoidea.

Helicter-inae[4] Pease, 1869; -idae Fischer, 1883 (Achatinellinae Gulick, 1873; -idae Kobelt, 1880, HSW:498). SubF: Tornatellinidae (which see) & Auriculellinae? F. of Pupilloidea.

Helminthoglyptidae: LMNA:24, see Xanthonycidae.

Hygromi-inae Tryon, 1866, LMNA:16, HSW:707; -idae Mlldff., 1890 (Trochulinae[2] Lindholm, 1927; Fruticicolidae[3] Hffm., 1928). SubF: L-inae (Xerophilae[3] Mörch, 1864; Leucochroidae[2,3] Westerlund, 1886; Helicellinae[3] Wenz, 1923, HSW: 702, not Adams, 1855; -idae LMNA:14; Geomitrinae Wenz, 1923; Jacostidae Pilsbry, 1948, LMNA2:1091). F. of Helicoidea.

Jacostidae: LMNA2:1091; see preceding.

Lanc-inae Hannibal, 1914, HSW:477; -idae Pilsbry, 1925. F. of Lymnoidea.

Lati-inae Hannibal, 1912; -idae Thle., 1926, HSW:473. F. of Limnophila.

Limaxia (F) and Limac-idia[5] (SubF) Raf., 1815; -idae Gray, 1821, Turton, 1831, LMNA2:521, HSW:605 (Agriolimacinae[4] Wagner, 1935). SubF: Parmacellinae HSW:605 (-idae & Cryptellidae Gray, 1860). Milacinae Ckll., 1935, LMNA2:563 (-idae Ellis, 1926). F. of Limacoidea.

Lucerna[4] "Humphreys" Swainson, 1840, type *L. acutissima* = *Helix lucerna acuta* Lam., 1816; not preoccupied by "Lucerna" Willughby, 1686 (Pisces), or "Humphreys" 1797 (see opinion 51) or "Fér." (citation of preceding in synonymy): L-idae; Lucerninae[4] Swainson, 1840 (Camaeninae Pilsbry, 1895; -idae Mlldff., 1898, LMNA:410; Amphidrominae Kobelt, 1902; Pleurodontidae Ihering, 1912, HSW:676; Chloritidae, Hadridae,[4] Papuinidae, Planispiridae, Rhagadidae[4] & Xanthomelonidae I., 1937–8). SubF: Megomphicinae (see Thysanophoridae)? Oreohelicinae Pilsbry, 1939, LMNA:412. F. of Helicoidea.

Lymnaea (*Lymnoea?*): Lymn-idia Raf., 1815 (SubF); Limnacea Blainville, 1824; -aeadae Risso, 1826; -adae Turton, 1831; -aeoidea Fitz., 1833; Lymneidae Orbigny, 1837; -aeidae, HSW:475 (Amphipeplidae [2] & Limnophysidae [4] Dybowski, 1903; Acellinae [4] Hannibal, 1912). F. of Lymnoidea.

Macrocycl-idae Thle., 1926, HSW:651. F. of SuperF. Rhytididae?

Megaspir-idae Pilsbry, 1904, HSW:557. F. of Achatinoidea.

Mesodont-inae Tryon, 1866 (Polygyrinae Pilsbry, 1895; -idae Ihering, 1912, LMNA: 575, HSW:579 in part). SubF: Triodopsinae Pils., 1940, LMNA:789. F. of SuperF. Mesodontinae.

Oleacin-inae,[5] -idae Adams, 1855, Gray, 1860, LMNA2:188, in part, HSW:562, in part (Glandinidae [2] Strebel, 1878; Cochlicopidae [3] Pils., 1900; Varicellarum HBB., 1941, genus LMNA2:200). See also Spiraxidae. F. of Oleacinoidea.

Onchid-ia Raf., 1815 (SubF); -iadae Gray, 1824; -iidae Adams, 1855; Oncidiidae HSW:486 (Oncidiellidae,[2] Peroniidae [2] & Scaphidae [4] Labbé, 1934). F. of Gymnophila.

Orthalic-ea Albers-Martens, 1860; -idae Tryon, 1866, & -inae, 1867, LMNA2:29, HSW:663. SubF: Bulimulinae Tryon, 1867, LMNA2:3, HSW:651 (-idae C. & F., 1873, LMNA2:1, HSW:651). Amphibuliminae Crosse & Fischer, 1873, HSW: 665. Odontostominae Pils. & Van., 1898, HSW:660 (-idae Wenz, 1923; Grangerellidae Russell, 1931). F. of SuperF. Orthalicidae.

Otin-inae Adams, 1855; -idae Chenu, 1859, HSW:468. F. of Actophila.

Partul-idae Pilsbry, 1900, genus HSW:658. F. of Cerionoidea or near Pupilloidea?

Paryphantidae: HSW:724; see Rhytididae.

Philomyc-ina Gray, 1847; -idae Keferstein, 1866, LMNA2:748, HSW:604 (Tebennophorinae [2] Morse, 1864; -idae C. & F., 1872). F. of Arionoidea.

Phys-oidea [5] Fitzinger, 1833; -ina Gray in Turton, 1840; -idae Dall, 1870, HSW:474. F. of Ancyloidea.

Planorb-ia Raf., 1815 (SubF); -ina Gray in Turton, 1840; -inae Adams, 1855; -idae Dybowski, 1903, HSW:478. SubF: B-inae (Bullinea [2] Oken, 1815; Camptoceratinae Dall, 1870; Bulininae Cr. & Fisch., 1880; -idae Germain, 1931; Isidorinae [4] Wenz, 1923; Protancylinae B. Walker, 1923). C-inae (Coretini Gray, 1847; Pompholicinae [1] Dall, 1866, 1870, -idae Henderson, 1924; Pompholycodeinae [2] Lind., 1927; Helisomatinae F. C. Baker, 1928). Choanomphalinae C. & F., 1880. Planorbulinae Pilsbry, 1934. Segmentininae F. C. Baker, 1945. Biomphalariinae Watson, 1954. F. of Ancyloidea.

Plectopylid-idae Mlldff., 1900 (Corillinae P., 1905; -idae T. in K., 1926, HSW:585). F. of Cerionoidea.

Pleurodisc-idae Wenz, 1923, LMNA2:1019, HSW:517, in part. SubF: Pyramidulinae Wenz, 1923 (-eae HSW:503). F. of Pupilloidea.

Pleurodontidae: HSW:676; see *Lucerna*.

Polygyridae: Man. Conch. 9, LMNA:575, HSW:579; see Mesodontinae.

Psiloicus[4] Morretes, 1952, or *Corus*[4] "Jouss., 1877" Strand, 1928,[1] type *Helix oblonga* Müller; see *Bulimus* and Strophocheilidae.

Punct-inae Morse, 1864, LMNA2:640; -idae "Gill" Pilsbry, 1895 (Laominae Suter, 1913, HSW:567; -idae Iredale, 1937; Patulastridae[4] Steenberg, 1925, see HSW:517; Paralaomidae[4] I., 1941). SubF: Patulinae[2] Tryon, 1866, section LMNA2:616; -idae Mlldff., 1890 (Charopidae Hutton, 1884; Endodontidae Pils., 1895, LMNA2:565, HSW:566; Thysanotinae G.-A., 1907; Goniodiscinae[4] Wagn., 1927; Discinae HSW:578). Ph-inae (Phenacohelicidae[4] Suter, 1892 = section, HSW:577; Otoconchinae Ckll., 1893; -idae HBB., 1938; Amphidoxinae HSW:575; Flammulinidae I., 1937; Gudeconchidae[4] & Pseudocharopidae[4] I., 1944). Helicodiscinae "Pilsbry" HBB., 1927, LMNA2:622, HSW:568. Rotadiscinae HBB., 1927, HSW:567. Stenopylinae HSW:569? F. of Arionoidea.

Pupill-adae Turton, 1831; -idae Pilsbry, 1905, LMNA2:868; -inae Pils., 1918, LMNA2:920, HSW:507 (Lauriinae Steenberg, 1925; -eae HSW:509). SubF: Vertigininae P., 1918, LMNA2:943 (-oidea Fitz., 1833; -idae Stimpson, 1851, HSW:503; Truncatellininae Steenberg, 1925; -eae HSW:503). Orculinae P., 1918, HSW:510 (-idae S., 1925). Gastrocoptinae P., 1918, LMNA2:871 (Includes *Abida* = *Pupa*[3] Drap., 1801; see *Cerion;* Chondrinidae[3] S., 1925; -inae HSW:511). Pagodulininae P., 1924 (genus HSW:510; Pagodininae[1] P., 1918). Nesopupinae S., 1925, LMNA2:1006 (-eae HSW:505). F. of Pupilloidea.

Rathouis-idae Sarasin, 1899; iidae Mlldff., 1902, HSW:489. F. of Gymmophila.

Rhytid-idae Pilsbry, Feb. 2, 1895 (Paryphantinae G.-A., 1895; -idae HSW:724). F. of SuperF. Rhytididae.

Sagd-inae Pilsbry, 1895; -idae Wenz, 1923, LMNA:978–983, HSW:581, in part. SubF: Aquebaninae & Platysuccineinae HBB., 1940. F. of Oleacinoidea.

Scolodens, **new name** for *Stenopus*[1] Guilding, 1828, Zoo. J. 3:527, type *S. cruentatus* Guilding: -idae (Stenopidae[1] Adams, 1855, Chenu, 1859; Scolodontidae HBB., 1925; Systrophiidae Thiele, 1926, HSW:596). F. of Limacoidea?

Scolodontidae: see preceding.

Siphonari-adae Gray, 1840; -idae Adams, 1855, Dall, 1870, HSW:471. F. of Thalassophila.

Spirax-inae HBB., 1939 (genus HSW:562): -idae HBB., 1955. SubF: -inae Streptostylarum (genus HSW:564) & Euglandinarum (genus LMNA2:188, HSW:565) HBB., 1941. See also Oleacinidae. F. of Achatinoidea.

Stenacm-idae Pilsbry, 1945. F. of Thalassophila.

Streptax-idae Gray, 1860, HSW:727. SubF: Z-inae; *Zophos*[4] Gude, 1911 (Selenitidae[1] Fischer, 1883; Austroselenitinae HBB., 1941)? Enneinae[4] Mlldff., 1903 (subgenus HSW: 734; -idae auct.; Ptychotrematinae Pilsbry, 1919, genus HSW: 733). F. of Achatinoidea.

Strobilops-inae Pils., 1918; -idae Hanna, 1922, LMNA2:848 (Strobilidae[1] Joos, 1911). See also Vallonidae. F. of Pupilloidea.

Strophocheil-idae Thle. 1926 (-chilinae Pils., 1902; -idae HSW: 650). See also *Bulimus*. F. of Cerionoidea.

Subulinidae: HSW:549; see Achatinidae (Stenogyrinae).

Succin-ida[5] Beck, 1837; -inae Adams, 1855; -idae Gill, 1871 (-eae Mörch, 1864; -eidae Tryon, 1866, LMNA2:771, HSW: 493; Catinellinae Odhner. 1950). SubF. Hyalimacinae G.-A., 1882. F. of Succinoidea (Heterurethra).

Systrophiidae: HSW:596; see *Scolodens*.

Testacell-ina Gray in Turton, 1840; -idae Adams, 1855, LMNA2: 230, HSW:565. F. of Testacelloidea, near Limacoidea.

Thyrophorell-idae T. in K., 1926, HSW:586. F. (?) of Limacoidea.

Thysanophor-inae Pilsbry, 1926, LMNA:984–994, HSW:582, in part. SubF: Megomphicinae[4] HBB., Jan., 1930, LMNA2: 506, HSW:578 (Ammonitellinae[4] Pils., Dec., 1930, LMNA: 554, HSW:579, genus p. 698; Polygyrellinae HBB., 1955)? F. of Arionoidea or SuperF. Mesodontinae?

Tornatellin-idae[5] Pilsbry, 1910, HSW:496 (Pacificellidae Steen., 1925; Elasmatinidae[4] I., 1944). SubF: Auriculellinae Pils. & Cooke, 1914, HSW:496 (-idae Odhner, 1922). Helicteridae or F. of Pupilloidea?

Trigonochlamyd-ina Hesse, 1882; -inae Ckll., 1891; -idae Mlldff., 1902, HSW:610. SubF: Parmacellillinae Hesse, 1926, HSW: 610. F. of Limacoidea.

Urocoptidae: Man. Conch. 15–16, LMNA2:103, HSW:668. See *Brachypodella*.

Urocycl-idae Simroth, 1889; -inae HSW:643. SubF. or Tribe: Trochonanininae Connolly, 1912 (-idae Germain, 1921; Trochozonitinae I., 1914, genus HSW:621; Ledoulxiinae[4] Pils., 1919). Peltatinae[4] G.-A., 1912 (Sheldoniinae Connolly, 1925). SubF. of F. Euconulinae or F. of Limacoidea.

Vaginulidae: HSW:489; see Veronicellidae.

Vallon-inae Morse, 1864; -iidae Pilsbry, 1900, LMNA2:1018, HSW:514; -iinae Watson, 1920 (Circinariidae[3] Pilsbry, 1898;

Acanthinulidae Steenb., 1917; -inae Pilsbry, 1918; Spelaeodiscinae & Aspasitinae[4] S., 1925). See also Strobilopsidae. F. of Pupilloidea.

Veronicell-idae Gray, 1840, 1842, LMNA2:1062 (Vaginulidae Gill, 1871, HSW:489; -inae, Sarasinulinae,[4] Semperulinae[4] & Meisenheimeriinae[2] Hffm., 1925). SubF: Imeriniinae & Pseudoveronicellinae Hffm., 1928. F. of Gymnophila.

Vertiginidae: HSW:503; see Pupillidae.

Vitrin-oidea[5] Fitzinger, 1833; -ida Beck, 1837; -inae Adams, 1855, LMNA2:499; -idae Gill, 1871, HSW:598. SubF: Vitreinae HBB., 1930, HSW:587, first 2 and last 2 genera (LMNA2:394–424; Helicellinae[1] Adams, 1855; -idae Tryon, 1866). Zonitinae, LMNA2:246–393, HSW:590 (Helicellinae[1] in part; Zonitidae Mörch, 1864, LMNA2:233, HSW:587; Hyaliniinae[2] S. & P., 1879; Godwiniinae[6] Cooke, 1921, HSW: 595). Gastrodontinae Tryon, 1866, LMNA:425, HSW:594 (Janulinae Wenz, 1923, genus HSW: 573; Poecilozonitinae Pils., 1924). Trochomorphinae HSW:622, in part (-idae Mlldff., 1890). Plutoniinae Ckll., 1893, HSW:600 (-idae Mlldff., 1902; Vitrip.[2] Collinge, 1893; Vitrinop.[2] Thle., 1926). Daudebardiinae Pilsbry, 1908, HSW:596 (-idae Kobelt, 1906). F. of Limacoidea.

Xanthonyc-idae Strebel & Pfeffer, 1879 (Lysinöinae Hffm., 1928). SubF: Cepolinae Hffm., 1928 (-idae Pils., 1934; -iinae P., 1939, LMNA:26). Epiphragmophorinae Hffm., 1928, HSW:697, type subgenus. Helminthoglyptinae Pils., 1939, LMNA:31 (-idae, p. 24). Sonorellinae P., 1939, LMNA:267. Humboldtianinae P., 1939, LMNA:395. Includes Eulotidae? F. of Helicoidea.

Xest-inae Gude & Woodward, 1921, HSW:632, type genus only; -idae I., 1941 (Naninidae[1] "Pfeffer" Martens, 1880; -inae Pfeffer, 1882; Ariophantinae G.-A., 1888, HSW:629; -idae Germain, 1921, HSW:611; Hemiplectinae G. & W., 1921). SubF. or Tribe: Macrochlamydinae[2] G.-A., 1888, HSW:626 (-idae Wenz, 1923; Tanychlamydinae HBB., 1928). Durgellinae G.-A., 1888, HSW:634 (-idae I., 1937; Sitalinae Sykes, 1900; -idae Germain, 1921; Ostracolethidae[4] Simr., 1901; Myotestidae Coll., 1902). Parmarioninae Blanf. & G.-A., 1908, HSW:642. Dyakinae G. & W., 1921 (-iinae Laidlaw, 1931; Staffordiinae HSW:632; Pseudoplectinae Thiele, 1934). Girasiinae HSW:640. SubF. of F. Euconulinae or F. of Limacoidea.

Zonitidae: LMNA2:233, HSW:587; see Vitrinidae.

From the preceding, Ancylidae, Helicidae,[5] Limacidae,[5] Lymnidae (or Lymnoeidae?), Onchididae and Planorbidae appar-

[6] At least a distinct tribe, including LMNA2:253-393 and (?) *Retinella* s.s.

ently would date from that indefatigable proposer of unidentifiable names, Rafinesque, 1815. Since, according to their numerous emenders, neither *Lymnoea* nor *Onchidium* were words of "Greek or Latin origin" (new article 4), should these form Lymnidae (cf. Blainville & Turton) and Onchididae, which admittedly would be improvements on their modern spellings? In the same year, would Bullinea Oken protect Bulininae, 1880, against Camptoceratinae, 1870?

Auriculidae, regardless of Röding, would date from 1821 or 1824. (Anyway, since 2 or 3 copies of a sales catalog, privately distributed, do not constitute publication, opinion 96 is invalid.)

Cerionidae, if dated from 1828, would include a special problem. Most authors cited *Pupa*[1] Drap., 1801 (-idae, 1828?), which is a synonym of *Abida* in Gastrocoptinae, 1918; although *Cerion uva,* the only species in *Pupa* Lamarck, 1801, was kept in the genus until near the end of the century. May Draparnaud's homonym be considered a usage of that of Lamarck? Similarly, if dated from Bulimidae,[1] 1828, Strophocheilidae, 1902, would be called by a family name based on *Psiloicus,* 1952, or *Corus,* 1928. Like *Pupa* Drap., and despite internal evidence, may the *Bulimus* of a century of authors be considered a misusage of Scopoli, 1777?

Carychiidae would start in 1829, Pupillidae in 1831, and Physidae,[5] Vertigininae and Vitrinidae[5] in 1833. Succinidae[5] (not -eidae) would go back to Beck, 1837.

Achatinidae would come along in 1840, despite Swainson's habitually eccentric spelling. But a family based on his Lucerninae[4] would replace Camaenidae or Pleurodontidae. Gray would initiate Amphibolidae, Arionidae, Gadiniidae, Siphonariidae, Testacellidae and Veronicellidae in the same year; Philomycidae in 1847; and Athoracophoridae (Janellidae[1]) in 1853. Coretini, 1847, or a name (1866) based on *Parapholyx,* 1922, would be prior to Helisomatinae, 1928.

H. and A. Adams, 1855, would add Chilinidae, Oleacinidae[5] and Otinidae. On the other hand, their Stenopidae[1] apparently would make *Happia* (*Scolodens*[4]) type of a family name prior to Scolodontidae, 1925, or Systrophiidae, 1927. But this change, like that of *Zophos*[4] (*Streptaxidae*) would fix the family-group names on "genera" which have been studied more than either *Scolodonta* or *Austroselenites.*

With *Hyalinia* (= *Oxychilus*) and *Vitrea* in synonymy, *Helicella* [1] "Lam." Adams, 1855, Gen. Moll. 2:118 ("Lam., 1812" Chenu), type now selected *Vitrea diaphana* Fitzinger, 1833, Beitr. Land. Oest. 3:99, has no provable connection with *Helicella* Fér., 1821, although both were adoptions of Lamarck's (1812) empty vernacular hélicelle. Helicellinae,[1] 1855, is also prior to Zonitidae, 1864. But if the Commission, which is studying the case, would validate Lamarck, 1812, with the first (Herrmannsen) type species, *Helix ericetorum,* Helicellidae, 1855, would include Hygromiinae, 1866. It is also listed, as a confuted misusage,[3] under *Helix,* where *Helicella* temporarily, let us hope, has become the name of *Euparypha-Xerophila-Theba.* (All roads lead to Pisa?)

In 1860, Gray would add Streptaxidae; and Albers-Martens would initiate Orthalicidae, under which Tryon, 1867, also subordinated Bulimulinae (-idae, 1873).

Morse's (1864) Punctinae would be the earliest of 4 names prior to Endodontidae, 1895, but his Valloninae (-iidae, 1900) would be prior to Circinariidae,[3] 1898. In the same year, Mörch would start Clausiliidae and Zonitidae, but his Ariantidae [4] might replace modern names. Apparently, his Caeciliae [1] would initiate a subfamily name based on *Cecilioides;* either it or Caecilianellinae [2] C. & F., 1877, would replace Ferussacidae, 1883.

Tryon's (1866) Mesodontinae would be prior to Polygyrinae, 1895, and his Patulinae [2] to either Endodontinae or Discinae. Equally bad, a family name based on *Brachypodella* (same type as *Cylindrella* [1]) and Pease's forgotten Helicterinae,[4] 1869, misbegotten on helicteres, would replace the well known Urocoptidae, 1898, and Achatinellidae, 1873, respectively.

Buliminidae,[4] 1879, although used in the Conch. Cab., would be longer and more confusing than Enidae, 1914; it is another of the wide-flung spawn of old bulinus Adanson. Clessin would also initiate Cionellidae. Stenogyridae,[4] 1877, would include Subulininae (-idae, 1928) and replace Obeliscinae, 1931.

Xanthonycidae, 1879, is prior to Cepolinae, 1928, or Eulotidae,[2] 1923. Euconulinae apparently would acquire the same date, 1879, which would make it prior to Godwin-Austen's (1888) Helicarioninae (-idae, 1908), Ariophantinae (-idae, 1921), Durgellinae (-idae, 1937) and Macrochlamydinae [2] (-idae,

1923), or Simroth's (1889) Urocyclidae. Similarly, Naninidae [1] Martens, 1880, based on Pfeffer's (1878) vernacular Naniniden, would make Xestinae prior to Ariophantinae. Sowerby's *Nanina,* 1842, is obviously an erroneous subsequent spelling, although accepted by me, 1936.

The cited superfamilies would be dated: Helicoidea,[5] Limacoidea,[5] Lymnoidea and Ancyloidea, 1815. Cerionoidea,[5] 1828? Pupilloidea, 1831. Succinoidea,[5] 1837. Achatinoidea, Arionoidea and Testacelloidea, 1840. Oleacinoidea,[5] 1855. Orthalicidae, 1860. Mesodontinae, 1866. Cionelloidea, 1879. Rhytididae, 1895.

Thus, as in genera, the rule of priority, if applied also to families, would favor the careless splitter, and establish names impetuously applied to aberrant and isolated forms. And why should homonyms, which are almost inseparable from misusages, deserve any special consideration?

The original code, although artificial, at least was planned by systematists for the good of all naturalists. The new rules seem to have been written by orismologists for the sole benefit of museums.

NOTES AND NEWS

Comment on a paper by David Nicol.—As the paper by David Nicol, "An analysis of the Arctic marine pelecypod fauna," Nautilus, vol. 68, no. 4, pp. 115–122, July 1955, has attracted some comment, it seems that certain points should be clarified. The Arctic collection on which the paper was in large part based had been made by Prof. G. E. MacGinitie, from dredgings in one small area near Point Barrow, Alaska. It had been left at the U. S. National Museum by Mrs. MacGinitie pending her analysis and publication of results. It was not (as Nicol himself admitted) a complete sample. I saw additional material that Mrs. MacGinitie brought to Stanford for study and know that at least three families, representing six or more genera, were not included. These added lots might well make a significant change in Nicol's comparisons—if we were to grant that he is justified in comparing an Arctic suite dredged offshore in one small area with a catalogue list of Floridan material from an area of indefinite size and undefined ecologic boundaries (L. M. Perry,

"Marine shells of the southwest coast of Florida," Bulls. Amer. Paleont., no. 95, 260 pp., 39 pls., 1950; revised by J. S. Schwengel, 1955). Hence, I feel constrained to point out that the conclusions Nicol reached may be vitiated by inadequate control of basic data.—A. Myra Keen, Stanford University, California.

Mesodon normalis (Pils.)—The land snail usually known as *Mesodon andrewsae normalis* (Pils.) generally has been considered to be a low elevation form of the mountain top *M. andrewsae* (W. G. Binney) because it differs only in being larger and in having a heavier shell. However, the two forms have been found together at three localities without any intergradation, which would indicate that they are distinct species. These localities are: below the Blue Ridge Parkway, near milepost 354, near the Pinnacle of the Blue Ridge, Yancey Co., North Carolina; Newfound Gap, Great Smoky Mtns. Nat. Park, Swain Co., N. C.; and Beach Gap, south of Sunburst, in Transylvania Co., N. C.—Leslie Hubricht.

Southern record for Pomacea cumingi (King).—Specimens of this species heretofore known only from Panama have been received from a lumber camp called La Nueva on the Rio Truando, dept. Choco, in northwestern Colombia (no. 195769 ANSP., from Mr. F. J. Barcroft of the U. S. Embassy, Bogotá). The Truando is a tributary of the Rio Atrato. The specimens may eventually be thought subspecifically separable, as they differ from the Panamic forms by having the suture less impressed and the interior of the aperture very dark, almost black in some examples. The largest one measures, height 48 mm., diameter 50 mm., spire eroded.—H. A. P.

Lysinoe sebastiana Dall, a correction.—By typographical error in the fourth line from the bottom of p. 43 of the October number, the height given as 0.03 mm. should be 30.3 mm.

Additional marine mollusks at Cape Ann, Massachusetts.—Recent records of marine mollusks collected as the result of intensive surveys at Cape Ann, Massachusetts, have been published by Dexter (Nautilus **56**: 57–61; **57**: 67–68; **58**: 18–24; **71**: 135–142; **59**: 69–70. 1942–45) and Clarke (Nautilus **67**: 112–120. 1954). Two species have come to hand which are not reported in the above references. On September 12, 1952, a single specimen of the chiton, *Lepidochiton ruber,* was collected

by the writer among sea-weeds washed ashore at Good Harbor Beach.

In the summer of 1947, Mr. Harold Geary brought to the writer six specimens of an octopus taken in otter trawls made in Ipswich Bay by the dragger *Lucretia* under command of Capt. Sam Nicastro. On August 26, the writer accompanied the crew on a trawling trip in Ipswich Bay to collect bottom organisms and to look especially for additional specimens of the octopus. While 105 specimens of squid were collected, no octopus was found that day. The six specimens of Octopoda captured earlier were identified by Dr. Grace E. Pickford of the Bingham Oceanographic Laboratory, Yale University, as *Bathypolypus arcticus* (Prosch). Four specimens were males and two were females. One of the females had a spermatophore attached to the first right arm. The specimens have been given to Dr. Pickford for further study.

Doubtless, the specimens of *Xylophaga* sp. reported from the Annisquam River (tidal inlet) at Cape Ann by Dexter (Nautilus **56**: 61. 1942) should be referred to *X. atlantica* Richards 1942 (see Johnsonia **3**(34): 152–154. 1955).—Ralph W. Dexter, Kent State University, Kent, Ohio.

The Kimball Valentine Collection.—The Academy of Natural Sciences of Philadelphia has recently received as a gift the extensive marine collection of Beatrice and Kimball Valentine of Washington, D. C. The approximately 2000 lots are mainly dredged shells from Florida and consist of many unusually perfect and rare collectors' items which were assembled over a period of ten years.—R. T. A.

First *Helix aspersa* in Hawaii.—On February 7, 1952, Q. C. Chock of the Territory of Hawaii Board of Agriculture and Forestry received from Masao Miyamoto, photographer for the University of Hawaii, a mature, live specimen of *Helix aspersa* Müller which the latter had found in his own yard in Kaimuki, Honolulu. The snail was released in my care and kept in quarantine in the insectary of the Hawaiian Sugar Planters Association Experiment station until its death about October 2, 1952. There was no reproduction.

This is the first record of the European brown snail in the Hawaiian Islands. Its mode of importation to the islands from its source is unknown. Two speculative methods of introduction

may be mentioned. (1) Hawaii imports great quantities of vegetables and fruits from California where the European brown snail is a common pest. An occasional juvenile specimen of the species could easily arrive here, undetected and alive, hidden among the leaves of vegetables. (2) Immigrant wives of Hawaiian servicemen returning from Europe could bring specimens back for food. The snail is reported to be easily raised and propagated at home.—Yoshio Kondo.

Henry Edward Crampton, 1875–1956.—Dr. Crampton died in the Presbyterian Hospital, New York City, February 26th. Among malacologists, he was known especially for his very thorough studies on the distribution and speciation of Partulidae, from islands of the Pacific, to which he made several expeditions. He will be missed by all who knew him.—H. B. B.

Defense of a predator.—In your issue of the Nautilus, Vol. 69, No. 2, October, 1955, pages 37–40, appears an article by Albert R. Mead entitled "The Proposed Introduction of Predatory Snails into California." This article was brought to the attention of the Invertebrate Consultants Committee for the Pacific, Pacific Science Board, at their annual meeting held in Honolulu on February 8, 1956. The Committee took strong exception to some of the statements and inferences appearing in the paper and have directed the undersigned, as Chairman of the Committee, to express to you their conclusions with respect to this article.

The tone of the paper suggests an effort on the part of the author to discredit one of the most important projects undertaken by the Committee; a project of great potential economic significance to the peoples of the Pacific where the African snail *Achatina fulica* is a serious threat to food crops essential to their general welfare. This project has been underway for nine years, has been heavily financed by the Department of the Navy through the Office of Naval Research, supported in every possible manner by the Trust Territory of the Pacific Islands and carefully planned and directed by highly competent and mature scientists thoroughly trained and experienced in the subject of biological control. In fact, some of the members of the Committee have gained both national and international prominence because of many achievements of importance in this general field of science. All are broadly versed in animal ecology, evolution and biology. In view of their long and success-

ful participation in biological control work, they would not be prone to encourage or engage in hastily planned or ill advised projects. Some of Dr. Mead's statements to which we take issue follow.

Dr. Mead begins his paper with reference to our distribution of the predatory snail *Gonaxis kibweziensis* as an invasion rather than a planned distribution. The very use of the word "invade" suggests the spread of something undesirable, such as a recognized pest. This *Gonaxis* has been known a long time, is not a pest and has never even been considered one. It has been carefully studied and is known to be carnivorous on other snails, which habit it has undoubtedly adhered to for countless generations.

Dr. Mead directly states that the only persons who want to spread *Gonaxis* are those in charge of this project. This is, of course, absurd. As soon as it became known to various institutions and a great many people in the Pacific, and elsewhere, that *Gonaxis* was at least one natural enemy of *Achatina fulica,* our Committee has been besieged from many sources requesting colonies of *Gonaxis.*

With reference to our introduction of *Gonaxis* into the Pacific, Dr. Mead asks "Is it actually justified." In consideration of the serious development of *Achatina* in the Pacific and our proof that *Gonaxis* feeds heavily upon the young *Achatina,* and that *Gonaxis* is not otherwise harmful, excepting for its attack on other non-arboreal snails, we are confident that this introduction is amply justified. With the march of civilization and commerce and the expansion of human populations within the Pacific, we consider the welfare of the human populations more important than that of the harmless native snails, which will inevitably suffer with the changes in vegetation coincident with the advance of man over the areas they now occupy. It is not unreasonable to assume that masses of uncontrolled *Achatina,* may of themselves supplant or suppress certain native snails, through sheer numbers, and do so as effectively as the *Gonaxis.* We consider even a moderate control of *Achatina* by *Gonaxis* justified. Recent investigations on the island of Agiguan still further strengthen our feeling that *Gonaxis* is an important enemy of the African snail. Heavy predation was noted wherever *Achatina* egg-clusters occurred, with a coincident scarcity of young snails in such areas.

In opposition to our project Dr. Mead states that "*Gonaxis* has not been scientifically proven to be capable of controlling *Achatina fulica*." If carefully studied by competent workers and then considered safe for introduction to new areas, how can proof of any degree of control be established without liberation? In the extensive introductions of beneficial parasitic and predatory organisms from one country to another during the past fifty years or more, if proof of results would be required prior to introduction, there would be no introductions, since proof would be impossible to determine in advance. This is a philosophy of defeatism. Had such a philosophy prevailed over modern man, we could not point with pride to the vast benefits that have accrued through the intelligent biological control work on introduced pests. As examples, this would have precluded the development of the present thriving citrus and sugar industries in California and Hawaii respectively.

Dr. Mead refers to the possible danger of *Gonaxis* assuming "strikingly different feeding habits" after passing through a number of generations in the "strange environment of Agiguan." With his probable training in animal behavior, animal ecology and evolution as a professor of zoölogy, it is impossible to understand how he could believe that such could be possible. If there is any change in the feeding habits of *Gonaxis,* after a few years residence on the island of Agiguan, only one is so far suggested. There seems to be evidence that *Gonaxis* is feeding and developing on *Achatina* more voraciously on this island than in its original habitat in Africa.

Though the title of the article relates only to the proposed introduction of *Gonaxis* into California, the body of his text covers our problem in the Pacific as well and in his last paragraph he refers directly to what he calls the "questionable wisdom" of introducing the snail into the Pacific. Finally, his remark or quotation from an old saying that "The remedy is worse than the disease" injects an inference that the whole project is dangerous and should not have been carried out. We cannot endorse such an inference since there is no evidence in this case that the remedy is worse than the disease. In fact, all evidence indicates the reverse.—C. E. PEMBERTON, Chairman, Invertebrate Consultants Committee for the Pacific, Pacific Science Board.

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THE PYRAMIDELLID MOLLUSKS OF THE PLIOCENE DEPOSITS OF NORTH ST. PETERSBURG, FLORIDA. By Paul Bartsch. Smithsonian Miscellaneous Collections, vol. 125, no. 2, 102 pp., 18 pls. 1955.—This is the Pyramidellid supplement to the "Pliocene Mollusca of Southern Florida with Special Reference to those from North Saint Petersburg," by Olsson, Harbison, Fargo and Pilsbry. The taxonomic treatment of the Pyramidellids by Dr. Bartsch is quite unlike that of the main report. Of the 113 species of Pyramidellids found at North St. Petersburg, all but one are described as new, and in most cases are based upon one or two specimens. While Olsson *et al.* report that about 32 per cent of the Pliocene species are represented in the Recent fauna, Dr. Bartsch has made no attempt to compare his many new species with those of other strata. No degree of morphological variation is accorded most of the species, and while most students would be inclined to recognize one or two species in the St. Petersburg *Chrysallida,* Bartsch creates 21 new species. However, he does recognize considerable variation in one species, having given careful study and innumerable illustrations of *Striopyrgus hybridus,* a species which is as variable as some *Chrysallida* or *Pyrgiscus.* Of the latter, Dall and Bartsch once stated (1909), "to describe these [varieties] would not aid science or the collector. . . ." It appears that the author believes the great variation in *hybridus* is due to hybridization, not just between two species, but of two genera, *Strioturbonilla* and *Pyrgiscus.* He, therefore, erects what he calls the "pseudogenus" *Striopyrgus.* It is interesting that no *Strioturbonilla* species have been found in this particular fauna, and it is likely that the strong, incised spiral grooves of *S. hybridus* have arisen independently as chance mutations without the influence of generic hybridization. In any event, *Striopyrgus* is nomenclatorially a new genus and not a so-called "pseudogenus" or "form genus" of botanists and horticulturalists. As the author states, a card catalog of names is helpful when working in so confused a group, and we draw to his attention two of his primary homonyms: *Odostomia cooperi* Bartsch 1955, non Dall and Bartsch 1907, and *O. stearnsi* Bartsch 1955, non Dall and Bartsch 1903.—R. TUCKER ABBOTT.